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THE SCIENCE TEACHER

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THE SCIENCE TEACHER

The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

Volume 26, Number 4 **May 1959**

Editor's Column

Let's keep the door open!

Today there is great pressure to use education as a screening device. "Let's phase out the loafers and the morons," so the argument goes. "If the school must render custodial care, let's at least get such pupils out of the way of those who are going somewhere." This sounds sensible. But who is who?

What are the infallible criteria which will categorize so neatly? Tests? Teacher ratings? Parental aspirations? Persistence? Motivation? Obviously all of these criteria have merit, but equally obviously, all of them have their limitations. Measures on any one of these criteria are always indirect. Formulas and quantitative data sometimes give a wholly unwarranted sense of precision. Even the best of tests have a substantial margin of error and many tests have very large margins of error.

There is a tendency to view standardized testing as a great panacea. Tests are indeed helpful, and, in fact, indispensable, but more should not be claimed than can be defended. Tests are incapable of measuring motivations. They cannot measure persistence, drive, and integrity, or the lack of opportunity to know!

The consequences of many intangible factors in education can be enormous when one considers the various degrees of cultural deprivation in the homes of millions of children. The impetus for growth and for the building of vision and wisdom will have to come from the schools for many such children, or it will never be.

Thus, it behooves us to consider most carefully and critically those strait-jacketed academic plans which would consign large numbers of children to some academic purgatory as "poor educational risks." The very human tendency to stereotype children must be resisted to the utmost, and such administrative devices as the multiple track program, however desirable they may be, will certainly greatly increase the hazard of such mental categories as "the saved," "the also-rans," and "the lost."

There is substantial evidence that the application of such criteria as those outlined above would have deprived us in the past of some of our most outstanding leadership. Not all famous scientists can be classified as geniuses, yet many of our educational trends in categorizing students seems to suggest that this is the case. Let us be chary in closing the door to opportunities. Let us be flexible in the shaping of our educational programs.

There is a present danger that too many adolescents may be coerced into making career commitments at too early a stage in their development. Secondary education should not primarily concern itself with specialization as such; its real purpose is to lay a solid academic foundation which will permit the widest possible latitude of choice among career opportunities and on which specialization can be solidly built at the college level.

The function of education is not to screen but to stimulate; not to restrict but to expand opportunities; not to close but to open doors.

HERBERT A. SMITH

THE SCIENCE TEACHER

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Readers' Column

May I take advantage of my membership in the National Science Teachers Association to express my dissatisfaction, in your *Readers' Column,* with a recommendation made by James B. Conant in his, *The American High School Today,* (McGraw-Hill Book Company, Inc., New York, 1959).

Dr. Conant's report is devoted in large part to a series of 21 recommendations addressed to school board members and school administrators for the purpose of improving public secondary education.

My objection is to a portion of Recommendation 3, entitled *Required Programs For All,* and reading, in part, as follows:

"A. GENERAL EDUCATION The requirements for graduation for all students should be as follows:

> four years of English, three or four years of social studies—including two years of history (one of which should be American history) and a senior course in American problems or American government—one year of mathematics in the ninth grade (algebra or general mathematics), and at least one year of science in the ninth or tenth grade, which might well be biology or general physical science. . . ."

Dr. Conant thus recommends that most of the students attending high school, a terminal institution for a great many, be permitted to graduate without having had a course in the life sciences or in the physical sciences, as the case may be.

Let us accept, for the sake of convenience, that man's knowledge can be classified into three major areas—the humanities, the social sciences, and the natural sciences. Dr. Conant, in Recommendation 3, suggests that most of our high school students be required to take no more than 1/16 of their total program in one of these areas—the natural sciences.

The justification for this recommendation is not apparent in the report. Dr. Conant does say, in Recommendation 9, that the academically talented should take a minimum of three years of science. But the greatest portion of our high school students are not in this group.

In the light of the great advances being made in science today, particularly in the areas of physiology and medicine, biochemistry, nucleonics, chemical synthesis, and engineering, and the accompanying necessity for maintaining a high degree of scientific literacy among *all* our citizens, it is, it seems to me, impossible to justify any high school program with a requirement of less than two years of study in the natural sciences—one in the life sciences and one in the physical sciences.

This minimum program will help to insure that more of our young people will be provided with a greater opportunity to obtain the subject matter background needed in order to better understand or to take a competent role in discussions concerning the fluoridation of a water supply system, the determination of what constitutes a radiation hazard, the indiscriminate use of antibiotics in medicine, the need for Salk vaccine and other prophylactic measures in our fight against disease, satellites and space travel, and other matters of science encountered by individuals in their daily living.

ABRAHAM RASKIN
Hunter College
New York City

I wish to thank you for the excellent material you have sent during the year, the information and ideas have been of great service in teaching.

J. O. MURPHY
Stratford Technical High School
Stratford, New Zealand

I regard the membership in your Association as the most valuable single source of information and advice that I know of, and have been far more than pleased with the contents of the magazine and packages which I received during the course of last year. The aids which are developed by the various firms in your country are far and away ahead of anything obtainable here.

D. C. PRICE
D. H. School
Mangakino, New Zealand

THIS MONTH'S COVER . . .

Delicate sheets of crystals—never before observed—erupt from the surface of stainless steel in corrosion studies by scientists at Westinghouse Research Laboratories. Growth of the crystals, the Westinghouse scientists believe, may cut tiny canyons into the metal's surface and lead to a type of metal failure called stress-corrosion cracking. The crystals, as photographed through an electron microscope, are magnified 9000 times, are only about half a millionth of an inch thick and 120 millionths of an inch high.

The electron diffraction pattern in the background was made by aiming a beam of electrons at the crystals. The rings show the crystal structure of the chrominum oxide crystals, or platelets, and confirms its composition as Cr_2O_3.

The Widening SCOPE of Cancer Research

By JOHN R. HELLER, M.D.

Director, National Cancer Institute, National Institutes of Health, Public Health Service, Department of Health, Education, and Welfare, Washington, D. C.

The study of cancer is the study of life itself—its normalcies and aberrations—and as such it presents an exciting and difficult challenge to the scientific imagination. The whole scientific community is beginning to realize that the study of neoplastic diseases will likely reveal many of life's secrets, from the intricacies of a single cell's metabolism to the complex interrelationships of an entire organism. And as cancer research contributes to our knowledge, it attains the status of a discipline in its own right.

The scope of cancer research is virtually boundless. It is rapidly expanding to encompass and utilize a wide variety of scientific disciplines as they apply to investigations of the nature, causes and characteristics of cancer, and to the problems of diagnosis, treatment, and prevention. Laboratory and clinical specialists have equally rich opportunities to make significant contributions in this field. But the all-inclusive quality of present-day cancer research is best illustrated by the concerted efforts of many groups and individuals whose varied talents and energies are being directed against the cancer problem.

In several respects, this kind of intensified, cooperative attack is unprecedented in the history of medical science. For instance, there exists a very real appreciation of the magnitude of the problem in all its facets. We have become increasingly aware of the extent of cancer in our population and of its damaging effects on our country. Cancer has climbed steadily from the seventh leading cause of death in the United States in 1900 to the second leading cause today. Last year, 450,000 new cases were discovered, 250,000 persons died of cancer, and there were some 700,000 cases under treatment. Local experience demonstrates to every citizen that cancer not only affects the patient and his family, but the community as well. And the economic impact on the nation cannot be overlooked; the annual hospital bill for cancer patients runs around $300 million, and the loss in goods and services amounts to about $12 billion. Cancer is clearly a public health problem. (See Chart.)

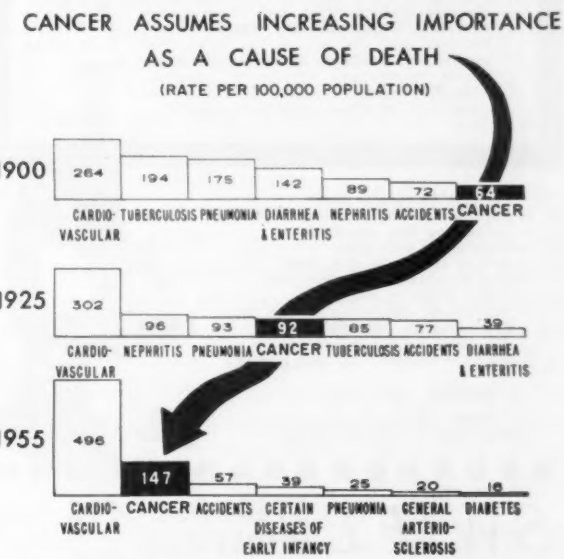
Realization of this fact is the impetus for the stepped up support of research during the past few years. In 1944, the American Cancer Society

raised $850,000 by public subscription, and by the next year donations rose to $4 million. The Congressional appropriation for the National Cancer Institute went from $548,700 in 1946 to $14,500,000 in 1948. Now the Society operates at a level of about $30 million, and the Institute at $75 million. Other government organizations and voluntary health agencies contribute lesser, though nonetheless substantial, amounts. A major proportion of these sums goes to support research. In fact, the financial backing given to cancer research by individuals, voluntary groups, the Government, and private industry has no parallel in past efforts to conquer a single disease.

Cooperative Activities

The professional educators make their contribution to cancer research in a different way. Their support and encouragement are invaluable in building up our working force of scientists, for the teacher-student relationship is a pivotal factor in a career decision. We at the National Cancer Institute are helping to meet the great need for training more young investigators by providing predoctoral and postdoctoral fellowships for special research training, and awarding grants to qualified academic centers to expand their training programs.

In our laboratories at the National Cancer Institute, on the grounds of the National Institutes of Health at Bethesda, Maryland, we currently employ about 700 scientists who are working on some 300 research projects. The largest share of our budget is allocated for grant support to scientists in independent foundations, universities, medical schools, and other institutions all over the United States. We believe that any legitimate research idea, wherever it originates, and any reputable scientist, should receive support. Building on this philosophy, we have extended our sphere to the international level, and thus achieved a new dimension in cancer research. In recognition of the increasing need for a unified attack against cancer, we award grants



and research fellowships to foreign investigators and invite foreign scientists to the United States for research and study.

What research areas demand our attention in this comprehensive approach to the cancer problem? What investigations seem to be giving the most promising results?

The search for drugs to cure cancer is one of the most exciting research activities today. This effort has grown into a vigorous operation that is a remarkable example of the cooperative principle in action. The Cancer Institute has helped to establish a national program of voluntary chemotherapy research and with its cosponsors—three other agencies of the Federal Government and two voluntary organizations—organized in 1955 the Cancer Chemotherapy National Service Center to coordinate the program. Hundreds of independent university and hospital investigators, research laboratories, and industrial firms receive support through grants and contracts from the Institute and are assisted by technical services of the Center. There are three phases in the program: 1) the acquisition and initial screening in mice for anticancer activity of many thousands of chemical compounds a year, 2) further testing of promising compounds in large animals and in the laboratory to develop safe doses for human trials, and 3) evaluation in extensive clinical trials.

Tumors in the mouse can be measured accurately, and the results of various experimental procedures easily evaluated. The growth of tumors is uniform in a highly inbred strain of mice, since all members of the strain have approximately the same genetic constitution.

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About 70 different materials are now undergoing clinical trials in over 150 cooperating hospitals all over the country. Some 3000 patients with such malignancies as leukemia, and cancer of the breast, prostate, lung, rectum, colon, and other sites are being treated with these compounds. The drugs are tested alone, in combination with other agents, and as adjuncts to surgery or radiation. Some have been in use against cancer for some time and are now being tested to obtain data under the controlled conditions of the clinical trials. Others are recently developed compounds, such as 5-fluorouracil. This drug is a member of a new class of tumor-inhibitory compounds, the 5-fluoro pyrimidines. These are pyrimidine antagonists, or antimetabolites, which are believed to accomplish their anticancer action by blocking an essential sequence of events in the biosynthesis of nucleic acid. In the Ehrlich ascites carcinoma of mice, 5-fluorouracil produced a 420 per cent increase in survival time. Several animals survived 100 days, at which time they were tumor-free. When the drug was given in adequate dosage to 35 patients with far advanced cancer, nine showed objective regression of solid tumors. The majority of patients reported subjective improvement and decrease of pain, but the drug produced marked toxic reactions. Related compounds are being studied to develop less toxic drugs. Another antimetabolite, methotrexate, is a folic acid antagonist that has been used for some time in the palliative treatment of acute leukemia. When tested by a special procedure developed by one of our scientists, methotrexate was the most effective of a group of 38 compounds in producing increased survival of mice with an advanced systemic leukemia. Control mice with this leukemia succumbed in about 10 days, whereas those receiving methotrexate had a median survival time of about 30 days. Under similar conditions, mice receiving 3′, 5′-dichloroamethopterin and 3′-bromo-5′-chloroamethopterin, which are chemical derivatives of methotrexate, had a median survival time of more than 100 days. Of course, these results are no guarantee of what might happen in clinical trials, but they demonstrate the feasibility of controlling systemic leukemia by drugs. They also show that advanced mouse leukemia is a good model system for the study of compounds made by altering the structure of known drugs.

Increasing attention is being devoted to the development of cancer tests and aids to diagnosis.

By present means it is difficult to diagnose cancer at its earliest localized stage before symptoms appear and while chances for successful treatment are at their best. However, there have been some encouraging advances in this direction.

Years of research have led to the present recognition of exfoliative cytology as a means of detecting early cancer of the uterus. The National Cancer Institute has pioneered in the development of this valuable diagnostic aid, and we are keenly aware that research progress has been greatly speeded by the interest and cooperation of universities and other medical and health groups in the communities where cytology projects have been established. A recent analysis of data obtained in our Memphis, Tennessee project showed that advanced uterine cervical cancer may be asymptomatic two to three years after onset, a finding particularly important since this kind of cancer can be detected during the symptomless period by cytologic examination of vaginal fluid, followed by biopsy.

A promising outgrowth of uterine cytology is research on application of the cytologic method to the diagnosis of cancer of other sites, such as the lung, colon, and stomach. Preliminary results on this work are encouraging. Also, we are hopeful that intensified work on the Cytoanalyzer, an automatic electronic scanner developed to speed microscopic examination of specimens obtained in the cytologic test, will substantially increase the usefulness of the technique.

There is now a large enough body of scientific information, based on clinical studies and animal research, to suggest a variety of approaches to the problem of cancer diagnosis. Certain tools, instruments, and techniques developed in other disease areas or in basic scientific work might be profitably applied or adapted to cancer diagnosis. We have recently established a diagnostic program at The National Cancer Institute that will employ a broad, inter-disciplinary approach to diagnostic research.

During the past few years, evidence that viruses cause cancer in animals has heightened interest in the possible viral etiology of human cancers. Very recently startling results in virus-cancer research were reported from a cooperative study by a Cancer Institute worker and another scientist at The National Institutes of Health. First the scientists produced multiple tumors in mice by inoculating them with cell-free extracts of parotid gland tumors or leukemic tissue that had been carried in tissue culture. All mice that developed such tumors had primary parotid gland tumors; some also had tumors of the thymus, adrenal glands, and mammary glands. The agent has been shown beyond question to be a virus, which not only produces malignancies in mice, but has the remarkable property of causing tumors in genetically unrelated types of animals—specifically, rats and hamsters. Moreover, the investigators have developed an immunizing agent that is 97 per cent effective in preventing the growth of tumors in hamsters challenged with the virus.

Much basic research needs to be conducted on viruses and hosts. At the Cancer Institute, we are rapidly expanding virus research by establishing a special laboratory section to strengthen these investigations, and by awarding grants for long-term support of intensive study related to the viral etiology of human cancer. Among the grantees are outstanding virologists in the United States and in other countries, several of whom have made significant contributions in other fields, as well as in cancer.

Although there are many secrets yet to be learned in this vast field of cancer, we should not overlook the fact that we now possess a solid foundation of carefully collected knowledge. And we have made tremendous advances in cancer control during the past two decades. Twenty years ago, one in four cancer patients survived five years after diagnosis of his disease, whereas today we are saving one in three. Our ultimate goal is to eliminate cancer as a major cause of suffering and death. We have every reason to believe that our present convergence and acceleration of effort is bringing us closer to the achievement of that goal.

The mouse in this photograph has an implanted tumor. After injection of a chemical, the tumor will be studied to determine any anticancer activity of the chemical.

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IN THE PALMS OF YOUR HANDS

By CHAUNCEY D. LEAKE

The Ohio State University, Columbus

In the palms of your hands, *Teachers of Science,** lie the futures of our peoples. How will you mold and fashion them, Potters of Destiny? Into sturdy useful bowls for daily service? Into crude and ugly dishes with neither dignity nor utility? Or into fragile over-decorated ornaments that crack when touched?

Why is there such responsibility on our science teachers? What's all the fuss over science anyway? These questions bring us into deep waters. We all know that we are living in an age of science, but what does this really mean, and why are we so concerned about it?

Some people, not knowing what science is about, are afraid of it. Others, not understanding science, may think its purpose is to give us personal comforts, health, and conveniences, without bothering about less pleasant aspects of an affluent society. Still others, confusing science with technology, may be excited by the multiplying gadgetry about us in computors, space satellites, and automation, while scorning the theorists who made them possible.

It takes individual brains to understand science, and collective wisdom to apply it beneficially to our welfare. These brains and this wisdom may come from the palms of the hands of our science teachers, if they realize the responsibilities and the opportunities before them.

What Science Is About

The concept of science is ancient, but its methodology is new. Science is an idea with complex ramifications about the "truth" about ourselves and the world around us. The purpose of scientific effort, like the religious endeavor, is to find this elusive "truth" about us and our environment, but in the faith that even unwelcome "truth" is better than cherished error. This implies a value judgment.

Blooming since the renaissance, science has developed a method for obtaining the real facts about ourselves and the universe in which we live, in such a way that the findings are able to be verified by people anywhere. This method is chiefly by measurement, with agreement on standards by which measurements are made.

The mathematical sciences proceed by experimental reasoning, within the logics of number or the logics of operational symbols. Remarkably some aspects of the world about us may be found to correspond to the results obtained by this process. Newton and Einstein brilliantly demonstrated the power of this method.

The natural sciences proceed by careful observation and accurate observation of phenomena, then by tentative explanations of what is observed, next by experimental testing of these explanations with rigorous control, and finally by conclusions based on the results of the experiments. From these conclusions general operating principles may be induced, as Harvey showed in demonstrating the circulation of the blood, or as Darwin found in the principle of adaptation as a factor in the survival of living things.

Concerned as it is with precise and verifiable knowledge about ourselves and our environment,

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*An address given at the Banquet Session of the Annual Convention of the National Science Teachers Association, Atlantic City, New Jersey, April 2, 1959. Dr. Leake is Assistant Dean and Professor of Pharmacology, College of Medicine, The Ohio State University. He is President-Elect of the American Association for the Advancement of Science.

science advances rapidly when significant mathematical principles are applied to natural phenomena. Mathematics gave Maxwell and Gibbs the power to analyze electromagnetism and thermodynamics; Planck the ability to develop quantum theory, and Einstein the capacity to outline general relativity, with the awful consequences of nuclear energy. Applications now, as by Schrodinger, of quantum theory to biology bring us to the beginning of understanding gene mutation, the control of growth and of cancer, and even of the mystery of life itself.

Always our curiosity about ourselves and the universe continues. Here is the great new frontier, the exciting adventure of exploring the unknown, even the vast unknown of ourselves, and how our brains work.

But what for? Here is the tough question which always confronts scientists. For what do we want to know as much as possible about ourselves and the universe in which we live? The answer is to be found in our sense of values.

What Science Is For

The moment we ask what science is good for, we move into the broad area of ethics or morals. Science is concerned with the logics of existence, the verifiable knowledge about ourselves and our universe. What we use this knowledge for is a concern of ethics, of our value judgments, of our motivations, of our needs, and of our conduct in satisfying them.

Actually the "truth" about ourselves and our universe, as far as it may be agreed upon, has ethical significance. It fixes certain limits about what is possible for us as individuals or as societies to do, whether we like it or not. Scientific principles, like gravity, act whether we like them or not, or whether we understand them or not. It is the part of wisdom to understand them.

Mostly we agree that all of us want and need individual and group satisfactions. These now seem to be built-in drives in our mid-brains, directed toward individual and species survival. We can dare to induce the naturally operating principles that relationships between individuals or groups of people tend to develop to the extent that they are mutually satisfying. This is a sort of biological ethic, but it embodies the ancient ethical principle of harmonious adaptation for mutual welfare, and is compatible with the ethics of major religious systems.

By general agreement then, science can best be applied for the welfare of people everywhere. It knows no political, racial, or religious boundaries. It is a human activity directed toward the benefit of humans everywhere.

At once it is clear, then, that in order really to mean anything much, the sciences must be balanced by the humanities. It is in the humanistic studies that we find the wisdom of men everywhere, and thus learn how to effectively apply our growing science to our common welfare.

Our science teachers will wisely encourage their enthusiastic science students to study deeply in the histories of cultures, in the economics, and literatures of peoples. Then our youngsters may see how their science may be wisely used. Here let it be remembered that the history of science is an admirable humanistic discipline in itself. That devoted Belgian refugee, George Sarton, showed clearly how the history of science can be an effective bridge between the sciences and the humanities.

The history of science may be the most stimulating way to be introduced into the technical details of scientific effort. Certainly it teaches well how human scientists are, and it clearly reveals how slow and painful is the positive increase in the verifiable knowledge of life.

Judgment in the Application of Science

If it is clear that science is for the welfare of all people, how may we best apply our scientific knowledge to this purpose? Here is the function of aesthetics; here is where the arts come in.

It requires artistic and engineering judgment successfully to apply scientific knowledge to the accomplishment of any purpose. In medicine, for example, where the purpose is to promote optimum health for individual persons, it takes much skill and judgment to use the appropriate knowledge available to accomplish the goal in any particular person. Indeed, medicine is often referred to as an art and science.

One can only acquire good judgment in the application of science to a worthy purpose by practice. Any artistic skill depends on practice. It is wise for scientists to develop artistic skill, taste, discrimination, and that judgment that can result in appropriate fitting of the knowledge to the purpose.

The Triangle of Teaching

We seem to have come to a triangular consideration of logics, ethics, and aesthetics. This triad was recognized by the great Greeks 2500

years ago. The interrelations of the triad are even more significant today than then. We will be wise to gear our whole teaching effort to the triangle of science, the humanities, and arts.

Rather than mean more in the way of burden for already overworked and under-paid teachers, this triangular approach should be refreshing, stimulating, and inspiring. Certainly it would seem to mean to give meaning to our whole teaching venture. It might give it real strength and provide genuine enthusiasm for all our teachers to be working together, whether in elementary or high schools, in colleges, or in graduate schools.

Again it is in the history of science that the function of science in our society can be clarified for those who are chiefly concerned in the arts or in the humanities. It is in the history of the arts or of philosophy that scientists may readily acquire the humanizing influence of our broad culture. Surely the histories of the arts, the sciences, and the humanities are more important in the world than political or military history.

Social Problems of Science

The current rapidity of scientific advance is explosive. It is causing much confusion, and the success of its applications is resulting in unforeseen difficulties. At once we are embarrassed by the immense amount of factual data we have accumulated. It is largely undigested. We can hardly store it satisfactorily in our libraries, much less find it when we want it. We must balance our laboratories with our libraries, if our science is to continue to serve us properly. We need to train many scientists broadly in the principles of science, so that they may analyze, digest, and generalize our vast pile of facts. If we are to use our tremendous factual data about ourselves and our universe, we must bring them together, see their interrelationships, and find the principles that operate through them.

It is becoming increasingly necessary to promote effective communication, not only among scientists, but also between scientists and the people. Often scientists do not even speak the same technical language, and there are many semantic troubles. Science reporting to the people is an art, not merely in spot news reporting, but more importantly in the interpretation of scientific principles to the public. The National Science Writers are doing a heroic job here, and they need encouragement.

Most large countries have associations for the advancement of science. The American Association for the Advancement of Science, like the British Association, assumes a major task in developing adequate communication between scientists and between science groups and the people. Anyone who is interested may join and help in this important enterprise. Here is a place for keen science teachers and for their students.

Very successful have been the science talent searches, well supported by industry. These attract huge throngs, and give abundant testimony to the success of science teaching. When our high school students give sophisticated exhibits and lectures on a range of stiff scientific problems from Boolean algebras to zoological growth factors, it can only be concluded that our science teachers are certainly on the job. Our colleges are scarcely prepared for these brains, but if we have them, the country is safe.

Our people must recognize our teachers: not as substitutes for parents, not as servants for parents, either, but as the responsible guardians of our culture. Our teachers deserve this recognition, not merely in handsome school buildings, but more importantly in better salaries, better social appreciation and prestige.

We have other serious social problems resulting from the explosive success of science: how about our too-rapidly growing population, with such an increase in the number of oldsters, as a consequence of vastly improved health, that they do not know what to do with themselves, nor does anyone else. How about the economic, social, and mental health aspects of aging? What are we doing to help prepare ourselves to come into old age with dignity, grace, self-reliance, and equanimity?

Our sudden conquest of nuclear power raises many tough problems: how can we use this great power wisely? How about the common dangers to us all of radiation exposure, whether from fallout, or contamination from wastes? What are we doing to control the dangerous pollution of our airs and waters, without a pure source of which none of us can continue life.

What are we doing about the understanding of ourselves, so that we may all obtain the mutual satisfactions we need? Are we willing to give up, some of us, because science is so hard, and let someone else tell how we may live? Are we drifting into Aldous Huxley's "Brave New World"? Or will authoritarianism, with its bureaucratic and dogmatic domination, overwhelm us?

(Continued on page 250)

Elementary School Science Bulletin

*** *Eligible for purchase under the National Defense Education Act (Public Law 85-864), if included in a local project approved by the department of education of the state.***

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Activity Breeds Interest in Science

By JOSEPH M. STEFANKO

Central High School, West Allis, Wisconsin

This report was an entry in the 1957-58 STAR (Science Teacher Achievement Recognition) awards program conducted by NSTA and sponsored by the National Cancer Institute, U. S. Public Health Service.

For some time I have felt that I was not getting optimum learning from my chemistry pupils. As in most classrooms, efforts were being made to bring minimum comprehension to the slower learners. The remainder of the class was not being *actively* encouraged to do more than gain mastery of the basic material. To be sure, the majority had been urged to experiment, collect, and inquire, but only a few had the deep interest to respond to such verbal suggestion. In fact, when I made stronger efforts toward encouragement, I still met with little success. It was only after constantly making new and greater efforts (over a period of several years), that the stimulation brought results. A teacher planning to seek pupil activity should expect indifference and should *continuously* seek to improve his methods.

It is true that few students prepared projects under science club direction (for science fairs, etc.), but it was my hope to secure activity from a sizeable portion of my classes. Of course this activity would be on a less intense scale.

About five years ago we started a system of extra credit points. To make certain that the brighter pupils participated in activities of some type, a definite number of activity points were required by anyone aspiring for an "A" grade. These points were needed in addition to an "A" average on the required material. Other pupils were informed that they could raise their grades by the earning of such points.

One of the primary aims was to get extended use of the chemistry books in our school library. After making a complete list of those available, each book was assigned a definite number of points. From time to time a number of books were brought into the classroom, and introduced to the pupils. This was done because few pupils will take the time to acquaint themselves with the books available. A few interesting comments were planned for each book. The names of those indicating an interest were taken and the

Figure 1.

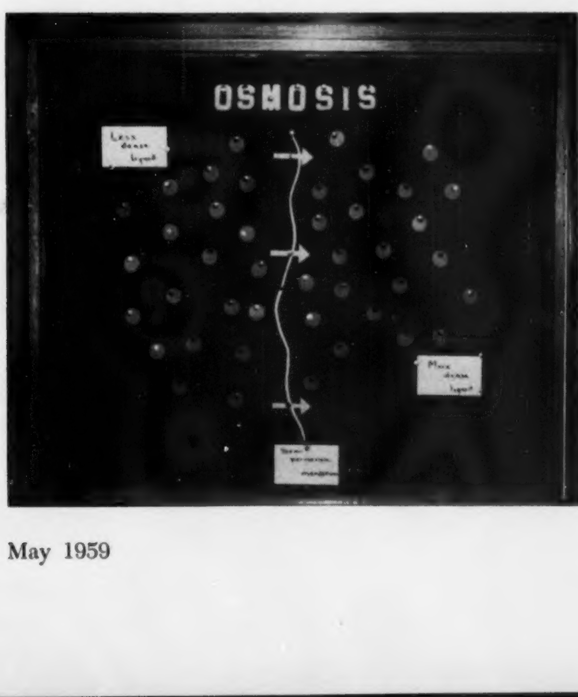
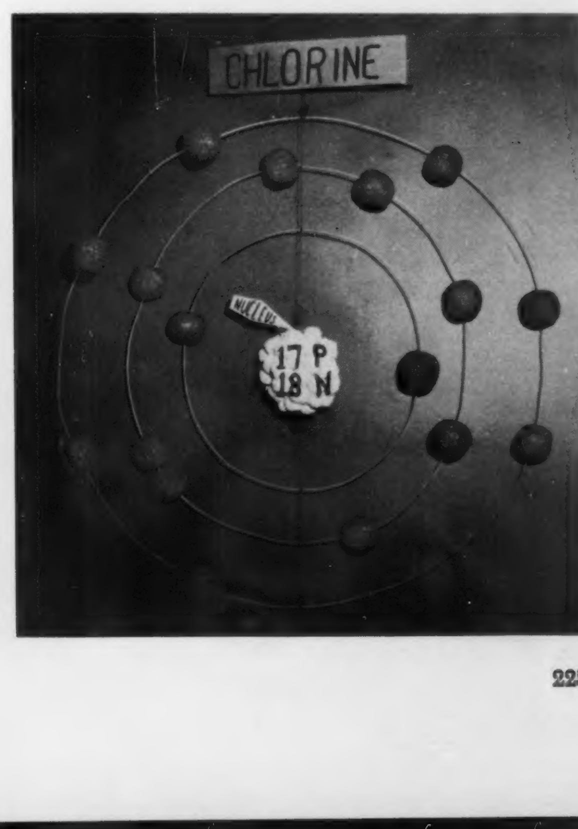


Figure 2.



librarian notified them when the book was available for their use. A brief written summary and the option of oral questioning were the means of checking whether the pupil qualified for the points. To compliment this aim for supplementary reading, we have requested the purchase of other good books of chemistry. A point is made to notify the librarian of any new book in the field, whenever one is published.

Classroom discussion revealed that few pupils sought out science articles in newspapers and magazines. To encourage this searching, the bits of science that were currently newsworthy were discussed *briefly* at the beginning of a class period. The pupils were then encouraged to follow the progress of such items in the succeeding days and weeks. We did not limit ourselves to chemistry in this discussion. Those finding articles pertaining to chemistry were permitted to summarize them for credit points. Always our aim was to insure activity, because by activity we knew we would breed interest.

In any science course the discussion will sometimes turn to hoaxes. We encouraged the pupils to try to perpetrate a hoax to deceive their classmates. Several tried trick photography in connection with the Russian satellites. It requires scientific thinking to expose such a ruse.

Efforts were made to learn what good periodicals (in science) were available at nominal cost. Copies were secured and they were presented to the pupils at the beginning of the school year. Circulating the copies among the pupils often results in a number of subscriptions, which are available at a reduced rate for school groups.

Credit points are also given for bringing in articles or materials (from everyday life) which involve a chemical principle we have studied.

Figure 3.

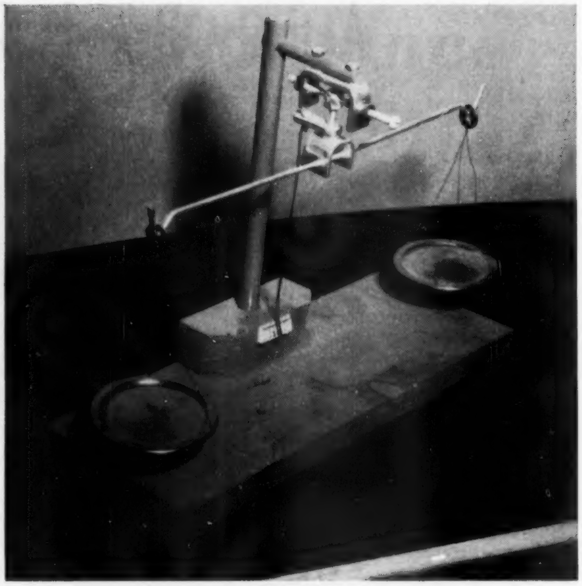


Figure 4.

For example, in the study of carbon, one pupil procured a gas mask which he cut in half to show its construction and contents. Our room now contains a number of devices that have been cut in half to show their construction. In the study of acetylene one person donated an obsolete miner's lantern which was made to operate on acetylene. After studying its construction, the boy made the necessary repairs and demonstrated it to the class. In the study of sulfur, we were made the recipients of a number of old sulfur candles. In fact, most of the articles brought in became donations to the school. During the study of X rays we secured X-ray tubes, developed and undeveloped medical and dental X-ray plates, or an old Coolidge tube.

Credit points can be secured for preparing a bulletin board display. This display must be built around some central theme studied in chemistry. (Figure 1 shows a typical display.)

Where applicable, experimentation at home is suggested. They are encouraged to try to show their parents some of the ideas they have learned. Until they have had one semester of chemistry, the setting up of a home laboratory is also discouraged. This is because for want of something to do, the promiscuous mixing of chemicals may result. It is pointed out that they should begin home experimentation only with the full approval of their parents, and that the school accepts no responsibility for their outside activities.

To suggest a home laboratory is not enough. Something must be done to originate the desire.

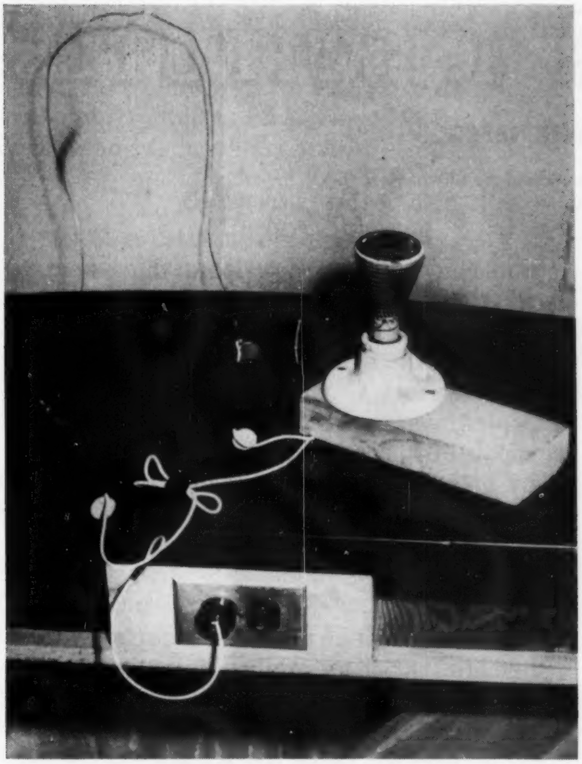


Figure 5.

We very often give students a broken graduate (which can be repaired by fire polishing) or some other piece of damaged or worn equipment. This often results in the desired impetus. Safe experiments that can be done in the home lab should be described from time to time. An out-dated textbook or supplementary lab manual becomes a treasured possession, if it is given to the proper individual. We furnish no chemicals to the pupils, except in special situations. For example, a small amount of copper sulfate or alum is issued to the pupil if he would like to try growing a crystal. We permit the pupils to sign for some equipment (such as electrodes for electrolysis), when we have some older supplementary equipment.

To this point only a brief glimpse of each phase of activity has been presented. We will be a bit more explanatory in this last phase. The construction of various illustrative and teaching devices is suggested. Former projects are shown to whet the imagination. Credit points are again the main source of stimulus. Originality is stressed. (Figure 2 shows a mobile of an atom.) To our knowledge this is the first time a mobile has been used to depict the three-dimensional atom. Other pupils have used other examples.

One boy constructed a three-dimensional, cross-sectional model of the rigging used in the Frasch Process of mining sulfur. (Student-constructed containers for demonstrating dust, volatile liquid, and gas explosions are shown in Figure 3.) Large display cartoons emphasizing chemical principals have been drawn by some of the artistically minded. Comical newspapers using the names of class members involved in chemical situations have been fabricated by others. A student-constructed balance is shown in Figure 4, and a device for cutting large-diameter tubing or bottles is shown in Figure 5.

To summarize, our aim is pupil activity on a large scale. We know these activities, if carefully planned and directed will breed interest. With interest the learning becomes more profound. Our aim is to have activities take place outside of class time, as class time is so urgently needed for the teaching of fundamental chemistry. It is our goal to have pupils feel, see, smell, and handle as many things as is possible. Only by constantly introducing new ideas, experiments, and techniques can teaching continue to be refreshing to the teacher, and of value to the students in their development.

1958 SUMMER INSTITUTES

By SAMUEL SCHENBERG

Director of Science, Board of Education of the City of New York

SUMMER INSTITUTES have, within a short period of five years, added a new dimension to teacher training in American education. These institutes are organized across the country to enable science and mathematics teachers to strengthen their backgrounds in their major and related fields of study and to keep abreast of modern developments which occur in explosive profusion.

In the past, only a relatively small percentage of high school teachers of science took graduate courses in specific science areas to fulfill a desire to keep up-to-date in their college major. By and large, most high school teachers took a master's degree in science education which provided the professional "know-how" and helped them to advance in the teaching profession. As time passed, these highly experienced teachers suddenly found themselves hopelessly behind the constant flow of new ideas and developments. They found that the science taught in the classroom no longer related to the science reported in the newspapers, in the magazines, over the radio, and on the television screen. Many of their students lost interest in a science which did not explain what was going on from day to day. The "know-how" could not operate effectively when the "know-what" was lacking.

Since world tensions made it imperative to interest and prepare many of our talented youngsters to specialize in science, a number of leaders in science and in science education, with the cooperation of far-sighted industrial and educational foundations, entered the science and mathematics institute field. They operated on the assumption that the most fruitful areas for direct and immediate attention were the high schools of our country within whose walls talented youngsters were interested in scientific careers. They became convinced that the high school teachers of science and mathematics were the key to the solution of the manpower problem. With the entrance of the National Science Foundation upon the scene, the institute training program went into high gear on a scale never before envisioned in American education.

It seemed desirable to evaluate the summer institutes in order to determine the extent to which they were attracting New York City teachers and, at the same time, to measure their impact upon the science and mathematics teaching in New York City. The study was initiated by a questionnaire which was distributed by the principals in 56 academic, 30 vocational, and 127 junior high schools to the science and mathematics teachers who participated in a 1958 Summer Institute Program.

Findings

An undetermined number of science and mathematics teachers applied for admission to the 1958 summer institute; 110 teachers were selected—94 men and 16 women. They represented a cross-section of the science and mathematics teachers who served from less than one year to 35 years in the secondary schools in New York City.

The 110 participants from New York City are presently teaching in 65 secondary schools, 79 of them in 40 academic high schools, 20 in 15 vocational high schools, and 11 in 10 junior high schools.

The data revealed that 23 or 20 per cent of the successful candidates possessed supervisory and administrative licenses. The largest single group of teachers, 32 or 29 per cent of the participants, were licensed in mathematics. The next largest group, 18 or 16 per cent, possessed chemistry licenses.

Questions 1, 3, 7

1. Name the college and location of the institute.
3. Name courses studied.
7. Was the institute sponsored by NSF? If not, name sponsor.

The teachers attended 30 institutes offered by 30 colleges in 17 states across the country. Ten of the institutes were situated in New York State and 2 of them were in New York City. Teacher-participants were able to pursue the study of biology in 4 institutes, chemistry in 16, physics in 19, mathematics in 13, radiation biology in 3,

radiation physics in 1, MIT high school physics course in 3, earth science in 5, and general science and social studies in 1. In many institutes teachers were required to take courses in 2 or 3 areas during the summer.

Questions 2, 4, 5, 6

2. State dates and duration in weeks.
4. How many hours were spent in attendance per day?
5. How many hours were spent in preparation per day?
6. Were you accompanied by your spouse? How many other dependents?

The 30 summer institutes ranged in length from 2 to 8 weeks. Most of the institutes, 25 or 83 per cent, were 6 to 8 weeks long.

The two-week course was sponsored by the New York State Education Department at the Oswego State Teachers College and was devoted to a study of electronics. The three-week course at Sarah Lawrence College was sponsored by the Joint Council on Economic Education, the National Science Teachers Association, and the National Council for the Social Studies. A workshop for both science and social studies teachers was held. The four-week institute was sponsored by the National Science Foundation at Oak Ridge, Tennessee, and was devoted to nuclear physics and radioactive isotopes.

The institutes were scheduled from 2 to 8 hours daily and the teachers claimed that they spent from 1 to 8 hours in daily preparation.

The replies indicate that 20 or 18 per cent of the teachers spent 3 or fewer hours in daily attendance, 65 or 59 per cent spent from 4 to 6 hours in daily attendance, and 25 or 23 per cent spent from 7 to 8 hours in daily attendance. The figures also show that 46 or 42 per cent spent only 1 to 2 hours in preparation, 38 or 35 per cent spent from 3 to 4 hours, 20 or 18 per cent spent between 5 to 6 hours, and 6 or 5 per cent spent 7 to 8 hours in daily preparation for their courses. These figures clearly indicate that most of the teachers found little time for relaxation.

Questions 12, 13

12. Are you planning to attend an institute next summer? Where? What type?
13. How many prior institutes have you attended in the last 5 years? (If you have attended prior institutes please list them on the reverse side and give the location and dates of each. Comments on each of these institutes will be welcomed.)

These questions were asked in order to determine whether the same or different teachers were attending institutes each year.

Eighty or 73 per cent of the participants had never attended an institute previously, 26 or 24 per cent attended one previous institute, 3 or 2 per cent attended 2 previous institutes, and one of the teachers attended 3 previous institutes. These data indicate that approximately one in every four teachers had previously attended an institute. Three out of 4 of the teachers attended their first institute in the summer of 1958.

Sixty-four or 58 per cent of the teachers decided that they would apply for admission to a summer institute in 1959, 29 or 26 per cent were undecided, and 17 or 16 per cent would not apply for admission to a summer institute in 1959.

Question 8

8. What were some of the "high points" of the institute?

The summer institutes gave the teachers the opportunity to go back to school for needed instruction in the latest advances in their own subject fields. They found this a most stimulating experience. They enjoyed personal contacts with the faculty members and guest lecturers, who were helpful and friendly. They acquired new techniques and became acquainted with the application and use of new procedures and equipment. Many found the trips planned by some institutes very stimulating. Teachers in the radiation biology institutes were pleased with the scaler presented by the Atomic Energy Commission. All of the teachers welcomed the opportunities for discussions and exchange of ideas with teachers from other parts of the country. They appreciated the provisions made for their families, and for planned social activities. They came back to their classrooms and students surer of themselves than they had been for many years.

One teacher, with 23 years of teaching experience, summed up the views of most teachers by writing, "In terms of vital experiences, instruction gathered, and uplifting morale, the institute was the most potent influence in my teaching career."

Questions 9, 10

9. In what ways could the institute have been improved?
10. What suggestions can you make for the improvement of future institutes?

The teachers pointed out a number of imperfections in the conduct of the institutes and offered suggestions for their elimination as well as for the improvement of future institutes.

Most of the teachers complained that too much work was crowded into each session. They felt that less work would have enabled them to secure a better understanding of the topics in the course of their presentation and development. Many advocated that all institutes be a minimum of 8 weeks in duration. Others felt that institute programs should be developed to span two or three summers and thus enable the teacher-participants to gain a high degree of mastery in the subject.

Most of the teachers were of the opinion that a great deal of the subject matter was never related to the needs and activities of high school teachers and therefore was only partially effective. They advocated better articulation between the high school teachers and the college professors within their administration.

Many teachers felt that some institutes were not as effective as they could have been because no attempt had been made to select a homogeneous group of teachers. The backgrounds of the teachers sometimes varied to such an extent that some found the pace too fast, and others too slow.

New York City teachers suggested that all summer institutes start on or after July 1. This would enable them to apply for admission to institutes all over the country.

Many of the teachers advocated the formation of a central bureau to process all applications. This method would eliminate the necessity for securing and filing many applications and would serve to avoid some being accepted two years in succession while others were unable to enroll.

Many felt the need for some prior preparation preceding the opening sessions of the institutes. They advocated brochures containing better descriptions of courses, followed by a list of topics and a suggested bibliography for all selected candidates. These procedures would enable successful candidates to make some preparation prior to the opening of the summer institute.

Teachers agreed that more time should be allowed for informal discussions with instructors and with one another. These discussions should take place during and after lectures and also in symposia arranged for one or two nights a week. Some were dubious of the teacher-student relationship which existed in some of the classes and

suggested the need for a more professional atmosphere in these classes.

A number felt that the directors paid no attention to the fact that the teachers were on vacation and needed some relaxation. Some did not provide convenient accommodations for families. Teachers recommended the use of one dormitory for all participants in an institute in order to promote more informal contacts during the summer session.

Question 11

11. How can the training you received be used to benefit (a) other teachers and (b) talented students?

Question 11 sought to determine ways and means of disseminating the new knowledge and enthusiasm, received by the teacher-participants, among other teachers in their schools and among their own and other students. That the Summer In-service Institutes were making an impressive impact upon teachers, schools, and school systems can be seen by the following contributions from the teachers. They made lecture notes and mimeographed material available to other teachers in their schools. They delivered talks at department meetings and at local meetings of teachers' professional societies. Some acted as consultants on methods for presenting new topics to other teachers. They stimulated other teachers to attend summer institutes.

The institutes were also having an effect upon the students. Teachers reported that they were able to enrich their own teaching. They encouraged students to engage in research and to work on projects for science fairs and other contests.

Conclusions

1. Science and mathematics teachers must be provided with the opportunity to keep up-to-date in their subject fields in order to keep pace with the rapid progress and changes which are taking place in these fields.
2. The institutes established by the National Science Foundation, the Atomic Energy Commission, and other public and private educational foundations are accomplishing this important function.
3. The planning and direction of all institutes for high school teachers should be based upon the joint efforts of college and high school educators. Only by such joint action can good articulation be secured and can provision be made for the integration of the new subject matter into the high school science and mathematics classrooms. An NSF committee of college educators and high school directors and supervisors of science and mathematics should be appointed to consult with the directors of institutes.
4. A central agency should be established by the National Science Foundation which would work with the institutes in the processing of all applications. Such an agency could avoid duplications, could make a homogeneous selection of participants, could assure a sound geographical distribution of participants, and could make selections which would provide adequate facilities for families.
5. The National Science Foundation should appoint a committee to set up institutes for those who have completed one. Institutes should not only present a wide variety of subject matter and experiences to meet individual needs and differences among teachers, but must also enable teachers to secure firmer foundations through institutes which have been planned to provide sequential training experiences.
6. The National Science Foundation should appoint a committee to draw up suggested bibliographies and lists of activities which teachers could use for self-enrichment and for the education and stimulation of talented youngsters interested in science and mathematics. Such publications should be revised annually. Suggestions for the use of new equipment and supplies as well as for various types of classroom, laboratory, and storage facilities would prove extremely helpful to high school educators and school officials.
7. The National Science Foundation should explore the possibility of supplementing its present institute program with teacher training via television.
8. Finally, there remains the realization that the most critical problem facing education today is the need for securing a sufficient number of well-trained teachers of science and mathematics to take care of the rising population of high school youngsters all over the country.

AO Reports on Teaching with the Microscope

Chemoreception in Protozoa...and what makes Daphnia's heart beat faster

Two Biology teachers, one from Middletown, Connecticut and the other from right here in Buffalo, N. Y. submitted teaching experiments that reached us on the same day. In some respects, these two experiments are so much alike as to suggest a sort of pedagogical telepathy. However, they are definitely different and we were happy to get both. Each has a certain classic simplicity, showing the straight line between cause and effect with a neatness that's sure to delight your young student scientists. Since both are relatively short we offer them together with the thought that you may be able to combine them in a single 45-50 minute period.

EXPERIMENT

Effects of Drugs Upon the Heart

By: Ted Stopyra
Middletown High School
Middletown, Connecticut

MATERIALS AND EQUIPMENT

1. AO Spencer 66 Microscope.

2. Daphnia (water fleas) obtainable from any aquarium supply store where they are sold as food for tropical fish; or from biological supply house.

3. Concave microscope slides (or plain slides).

4. Medicine droppers.

5. Different types of drugs (pill or liquid form) which may be diluted to strengths, as desired. The following drugs may be obtained from a co-operative physician.

- **A.** Tranquilizers—Compazine.
- **B.** Barbitol—Aberate
- **C.** Depressants—Altarax
- **D.** Stimulants—Dexedrine Sulfate, Wyamine Sulfate.
- **E.** Alcohol—40%, 50%, 60%, 95%.

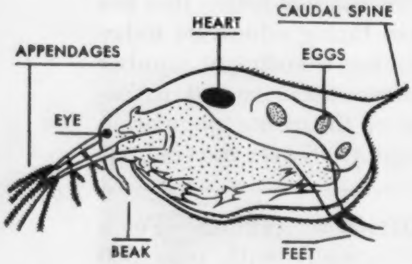


Fig. 1 **DAPHNIA**

PROCEDURE:

1. Select one or two of the Daphnias from a culture with medicine dropper and deposit on concave slide. With same dropper, withdraw as much water as possible from slide, leaving just enough to keep Daphnia alive.

2. Place slide under microscope and observe under 10X objective. One observes the transparent animal immediately with the heart beating very rapidly.

3. Place a drop of one of the diluted drugs on the slide; the heart will react immediately. By repeating the experiment with remaining drugs one can observe the relative effects of tranquilizers, depressants and stimulants on the heart.

EXPERIMENT

The Reactions of Protozoans to Nutrients and/or Dissolved Substances

By: D. S. Po-Chedley
D'Youville College
Buffalo, New York

MATERIALS AND PREPARATIONS

1. Culture of Paramecia or Euglena (obtained from biological supply houses and easily subcultured in finger or stacking bowls).

2. Capillary pipettes: prepared by drawing out medicine dropper so that the bore is about 1mm diameter.

Capillary tubes—about ½ in. long—prepared the same way, or, 1mm diameter capillary tubes can be purchased from scientific supply house.

3. AO Cycloptic Stereoscopic Microscope.

4. Syracuse dishes, or watchglasses or Petri dishes.

Fig. 2

PROCEDURE:

The plan is to keep the fluid additive in a restricted region long enough to permit the cells to differentiate between it and their normal environment.

1. Fill Syracuse dish half full with water.

Fill capillary tube with a test solution, viz: sugar, salt, glacial acetic acid, formic acid, alcohol, calcium carbonate, etc. (the tube fills easily via capillary attraction).

2. Use the stereoscopic microscope and capillary pipette to gather a quantity of the organisms.

3. Place the Syracuse dish in focus under the stereoscopic microscope, carefully lay in the nutrient tube with forceps, (Fig. 2) add the microorganisms (Fig. 3)—observe results.

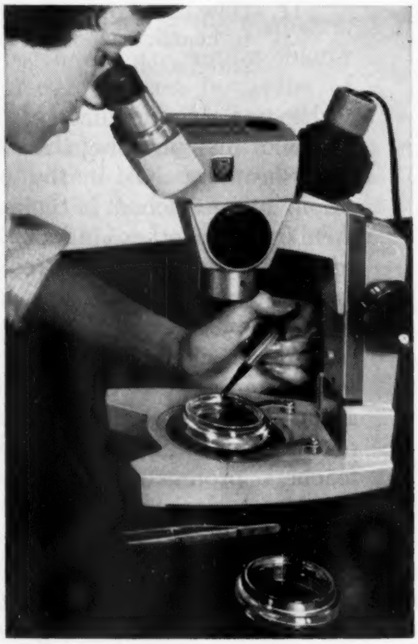


Fig. 3

OBJECTIVES:

This experiment illustrates a protoplasmic property called chemoreception. The cells either respond positively, by clustering around the open regions of the capillary tubes where diffusion of the test fluid occurs or they may respond negatively, by contacting the material and rapidly moving away. It may kill instantly so that a ring or arc of dead cells form at the periphery of the diffusing substrate. This principle, of chemoreception, here associated with the single cell reactions of protozoa may be projected to study the behavior of more complex organisms.

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Solar Energy Studies for Third Graders

By MILTON O. PELLA
University of Wisconsin, Madison
and DOROTHY RAASCH
Bayside Elementary School, Milwaukee, Wisconsin

THE STUDY OF THE SUN by elementary school children has been limited largely to: it is the center of the solar system, it lights and heats the earth, it causes the moon to shine, and its light is used by plants in food manufacture. Is this all these children can learn about the sun?

Problem:

What can one third-grade class really learn?

Method:

1. One third-grade class at Bayside School, Milwaukee, Wisconsin was selected as a typical group of children of this age. The I.Q. range was from 86 to 131.
2. The teacher developed her background knowledge of solar energy through reading, conferences, and viewing films.
3. The intial amount and kind of knowledge of solar energy possessed was determined by having each child report orally what he knew about the sun. Each oral response was recorded.
4. Films, *Our Mr. Sun* and *The Bell Solar Battery*, and filmstrip *Our Sizzling Sun* were shown.
5. Experiments with lenses, mirrors, types of absorbing surfaces, devised apparatus to show the greenhouse effect, plants grown in light and darkness, solar-powered telephones, devised solar-heated houses, and a solar still were done.
6. Pupils read stories and facts about the sun.
7. The teacher prepared a bulletin board.
8. At the completion of the study, the pupils again reported orally what they knew about solar energy and these were individually recorded.
9. The two lists of statements were compared as to number and complexity.

Teaching Methods Employed

1. The topic of solar energy was introduced by the teacher through the discussion of a teacher-prepared bulletin board concerned with solar energy.
2. Initially and as the study progressed the children asked questions about the sun. These were listed on a chart and on the bulletin board.

a. How hot is the sun?
b. Will the sun ever burn itself out? Why?
c. What is the fuel for the sun?
d. When there is an eclipse of the sun, what part shows?
e. What do we call the upward shooting of the bases from the sun?
f. Why can coal be called buried sunshine?
g. How is water power related to the sun?
h. Why can we say wind power is really sun power?
i. What causes the arms of the windmill to turn?
j. When animals worked for man, what fuel did they use?
k. When was the Bell solar battery invented?
l. What does the solar battery change sunlight into?
m. Why won't the solar battery wear out?
n. What is the main part of a solar cell?
o. Where does man get this material to make the solar cell?
p. How can solar-battery operated telephones be used at night or on cloudy days?
q. Where are solar-battery operated telephones being used?
r. How big would a solar battery need to be to run a desk lamp?
s. Why are eaves used on solar houses?
t. Why are there many windows in solar houses?
u. What are solar cookers? Why do they have that shape?
v. What is the water cycle? How does the sun cause water to evaporate?
w. When does the most heat enter a solar-heated house, in summer or winter?
x. How are solar-heated houses heated at night or on cloudy days?
y. Why do solar-heated houses have so many windows?
z. Is solar heating cheaper than other heating systems?

On cloudy days the pupils read to find answers to these questions or to some additional questions asked by the teacher. The children shared materials and worked in small groups.

3. On sunny days: the following were carried out by the pupils assisted by the teacher.

a. Use an ordinary household thermometer. Focus sunlight through a magnifying glass so that it comes to a point on the thermometer bulb. Watch the liquid in the thermometer.

b. Prop up a thermometer near a sunny window, but not in the sunlight. Hold a concave mirror so that it focuses the sunlight onto the bulb of the thermometer. Hold the mirror in this position. Watch the liquid in the thermometer. Use small and large concave mirror. Compare effects.

c. Fill two cans of the same size, one shiny, the other painted dull black, with water of the same temperature. Cover each can with cardboard or wood which has a hole for a thermometer. Put both cans in direct sunlight. Take the temperature of the water of each can at five-minute intervals.

d. To show the greenhouse effect, put sand or soil in a glass container such as an aquarium or battery jar. Put a thermometer inside the container. Cover the top with glass. Place a second thermometer on the top side of the container. Set this outside in direct sunlight. Observe the initial temperature. Observe both thermometers periodically for about one half hour.

e. Repeat Experiment d., but paint the sides and top of one container white to see what effect this has on the inside temperature. The glass of the other container is left clear. Compare the inside and outside temperatures of each container.

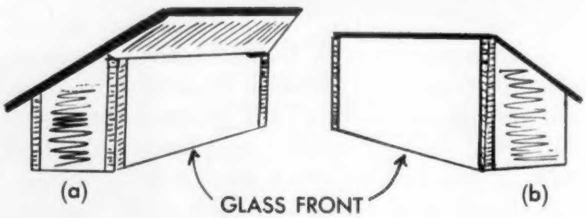
f. Support a large concave mirror or reflector directed towards the sun. Roast marshmallows at the focal point. (While doing this protect your eyes from the sun.)

g. Take two healthy geranium plants. Place one in a dark location and one in a sunny window. Add the same amount of water to each. Allow to stand for a few days. Remove some leaves from the plant which had been in the light. Drop the leaves in boiling water for a few minutes to soften them. Then boil them in alcohol until the green color has been removed. (Do not heat alcohol over an open flame.) Rinse the leaves in water. Test for starch by adding a few drops of iodine. Rinse in water. If the color is brownish-purple, starch is present. This shows that photosynthesis has taken place. Repeat this procedure with the leaves of the plant which had been in the dark. Compare the results of the starch tests.

h. Use the telephones supplied by the Wisconsin Telephone Company with the flashlight batteries. Remove the batteries, insert strips of brass as connectors so as not to break the circuit, and use a solar battery as the source of energy. If the sun is shining, place the solar battery in direct sunlight. Have children test the phones. If the sun is not shining, use the photoflood light provided by the company. Turn off the light. Test the phones.

i. Use the solar battery with the oscillator supplied by the telephone company. Have a child make a small sign or cartoon for advertising. Operate it in sunlight. Use it with and without the photoflood lamp. To simulate a cloud, hold a cloth such as a handkerchief between the light and the solar battery.

j. With a magnifying glass burn holes in paper. This also will start a fire. Do this only under strict supervision. Compare the results using white and black paper.



k. Build two small houses of the same dimensions and materials as shown in diagram. Construct the front of each house from glass. One house should have an overhanginch roof to give shade over the front window (a). The other roof should be flush with the front of the house (b). Place a thermometer in each. Compare the temperature in each. If carried on during the winter, compare the indoor and outdoor temperature.

l. Make a solar still. The apparatus is shown in Column 3. Make a support for it, cut

off the lower bar of the triangle of a coat hanger. Cut off the hook, leaving about one-half inch sticking up. Tape the straight piece which was cut off from the bottom to the top of the hanger, and bend it to form a right angle. Tape this to the top of a ringstand. Slip a large unventilated plastic bag over the hanger support. Put a dish containing a sponge and salt water on the ringstand about half-way down the column. Set a tumbler at the bottom of the ringstand, and draw the bottom of the plastic bag together, taping it to the mouth of the tumbler. Have this apparatus set up in a sunny part of the room. To speed up the process a bright light might be set up to shine on it. The water that condenses on the sides of the bag and runs past the dish into the tumbler can be tasted. The salty remains in the dish can also be tasted.

m. Set a radiometer in the sun. Watch it. Set it in the shade. Watch it.
n. Fill two pans of the same size to the same level with soil. Insert thermometers at the same depth in each. Do not let the thermometer touch the bottom of the pan. Put both on a sunny window ledge. Prop one up to get direct rays. Lay one flat to get slanting rays. Leave the pans in the sun for thirty minutes. Compare the temperatures without removing the thermometers from the pans.

4. The films and film strip were shown.

5. The teacher used the chalkboard as a supplement to the study of solar engines, solar stills included in the life raft equipment during World War II, and the effect of concave mirrors and convex lenses on rays of light.

Results

TABLE I

Oral Responses Before Studying the Unit

1. The sun is round.
2. The sun is hot.
3. The sun could cause fires in dry regions.
4. The sun is not on fire, or it would burn up.
5. The sun is a bunch of gases.
6. Gases shoot up high from the sun.
7. The sun gives us light.
8. The sun helps grow our plants.
9. We could not live without the sun.
10. The sun makes plants green.
11. The sun gives us heat, without it we would freeze.
12. The sun shines, even on cloudy days.
13. The sun shines on half of the earth at one time.
14. The sun is a star, it is the star closest to the earth.
15. The sun is a million times bigger than the earth.
16. The sun is the center of the solar system.
17. We travel around the sun.
18. The sun is not hollow.
19. Moonshine is reflected sunshine.
20. There are eclipses of the sun.
21. The sun has sunspots.
22. Sunspots are storms on the sun.
23. We can cook by the sun. Use a piece of cup-shaped tin foil.
24. Future cars might run on sun power.
25. Houses can be heated from sunlight.
26. We can get sunburned.

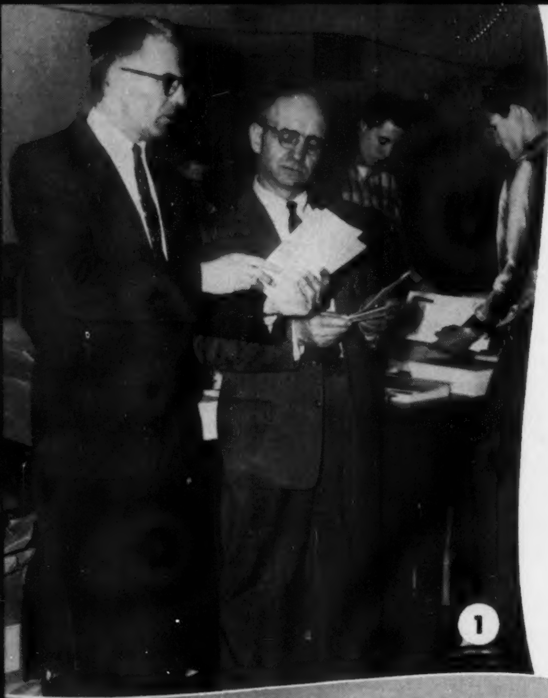
The source of some of these statements is not known; however, others as 1, 2, 4, 5, 7, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, and 22 were covered in a study of the solar system early in the year.

TABLE II

Oral Responses After Studying the Unit

1. The sun is a star.
2. The sun is the nearest star.
3. The sun is 93,000,000 miles away.
4. The rays of the sun take about eight minutes to reach us.
5. We get light and heat from the sun.
6. Only a small amount of the sun's light and heat reaches us.
7. The sun's light and heat radiates out in all directions.
8. The temperature at its surface is about 10,000° F.
9. The temperature at the middle is about 30,000,000° F.

(Continued on page 252)



have pac

What is the story behind the Packet Service of NSTA?

This pictorial summary gives you the answer. During the past ten years of operating the NSTA Packet Service, 400,000 packets have been assembled and distributed throughout the country. Each of these packets has contained from 6 to 10 different business-sponsored teaching aids.

Glenn Warneking, Assistant Executive Secretary of NSTA, spearheads this packing, packeting, packaging project. Through the cooperation of Paul A. Snearline, principal of Western High School in Washington, D. C., arrangements were made to use the facilities of the high school and the help of various student groups to *pack* the *packet*. The student groups use this activity as a fund-raising project, and they are reimbursed by NSTA for their work at commercial rates. The over-all packet supervisor at Western High School is Russell Coover, teacher of mathematics. For supervision of Packet 46, recently assembled as pictured here, Lt. Paul C. Nassetta, military science instructor, handled the project assisted by students of the Fourth Regiment of Cadets. Richard Green, student yearbook photographer, reports the activities with his camera.

Richard Green

cket—will send

GLENN WARNEKING, who has headed this operation for the past three years, is also in charge of membership services including circulation of all publications.

(1) Paul A. Snearline, Principal of Western High School, and Russell Coover, teacher of mathematics, examine packet material.

(2) Boxes to open, material to fold and assemble.

(3) Down the packet assembly line. Left to right: Val Weaver, Gary Stair, Larry Livingston, Anwar Shaikh, Albert Barnes, David Clarke, and Richard Stotler.

(4) Cut, check, and sort. William Rothe and James Head begin the operation.

(5) Every item must be checked, every packet complete. David Burnham (seated) takes the count as Lt. Paul C. Nassetta instructs Gary Stair on Packet 46.

(6) Assembly line in readiness, no time for pauses as packet is stuffed.

(7) Packet 46 ready for mailing.

(8) Packet packed, boxes filled, mailing trucks loaded, the packeteers review the operation in a more relaxed manner.

8

7

4

5

6

Why Satellites Remain in Orbit

By FRANKLYN M. BRANLEY

American Museum—Hayden Planetarium, New York City

THE EXPLANATION for the continued revolution of man-made satellites around the earth is not in any way concerned with centrifugal force. For that matter, neither are the explanations of moon's motion, of the motion of planets about the sun, or of Lunik about the sun related to centrifugal force.

We frequently read of activities designed to reproduce the conditions that exist in the earth-satellite system. The activity invariably involves spinning a stone at the end of a string. The demonstrator says that the stone is pulling away from the center; the factor comparable to the velocity of the satellite. The string is the gravitational factor.

Such demonstrations are quite erroneous, for centrifugal force is not involved in the explanation at all. Indeed, upon careful consideration of the conditions, and upon application of laws of motion, it becomes quite apparent that gravitational attraction supplies the complete explanation. The satellite falls toward earth continually, as can be shown readily.

Let us consider Figure 1. *E* is earth, and *S* is a satellite. We shall call the masses M_E and M_S respectively. The gravitational force of *E* upon S, and which pulls the satellite toward earth is *F*. The distance between earth and the satellite is *r*. Newton's Law of Gravitation enables us to determine the magnitude of *F:*

$$F = \frac{GM_EM_S}{r^2}.$$

(G = universal gravitation constant.) The equation clearly indicates that F changes only as r (the distance) changes. Also, the force never becomes zero unless the two masses are at infinite distance. Therefore, the satellite is always pulled toward earth. Also, as long as the orbit of the satellite is circular, *r* always has the same value; therefore, *F* always has the same value.

If the satellite is being pulled continually toward earth, why doesn't it fall toward earth? This is where misconception often enters the explanation. It is pointed out that the inward gravitational force on the satellite is delicately balanced by an outward centrifugal force resulting from the velocity of the satellite. Therefore, the satellite cannot fall to earth. This is wrong.

There is only one force operating on the satellite and this is the gravitational force of earth. No centrifugal force is exerted on the satellite, and the gravitational force is unbalanced, indeed, it must be. At first it may seem paradoxical that the satellite can be under the influence of one unbalanced force, and still not fall to earth. However, a perusal of the Laws of Motion explains the phenomenon completely.

The first law of motion tells us that a body remains forever in a state of rest, or it moves uniformly in a straight line unless exterior forces are exerted upon it. Therefore, if no forces are exerted upon a body, the body remains at rest, or it moves in a straight line. A more relevant factor for our purposes: If the exterior forces are balanced, there is effectively no force exerted upon the body, and so the same situation prevails—the body remains at rest or it moves in a straight line. The satellite moves in a curved path; therefore, it is apparent that an unbalanced force is exerted upon it.

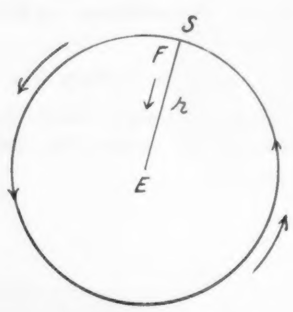


Figure 1.

Acceleration is another factor involved in this explanation. Acceleration is the rate at which the velocity of a body changes. The velocity can change in either, or both, of two aspects: 1) in magnitude, or 2) in direction. The second law of motion asserts that when a force is exerted upon a body, the body is accelerated. The degree of acceleration is proportional to the force, and the acceleration takes place in the direction in which the force acts. We have already estab-

lished that the only force on the satellite is the gravitational attraction of earth. The direction of the force is toward the center of earth; therefore, we know that the satellite is accelerated toward earth. Many people find this idea hard to accept, because they fail to consider that the acceleration does not involve change in velocity; the acceleration involves change of direction.

The situation is shown in Figure 2. From the first law of motion we know that the satellite is

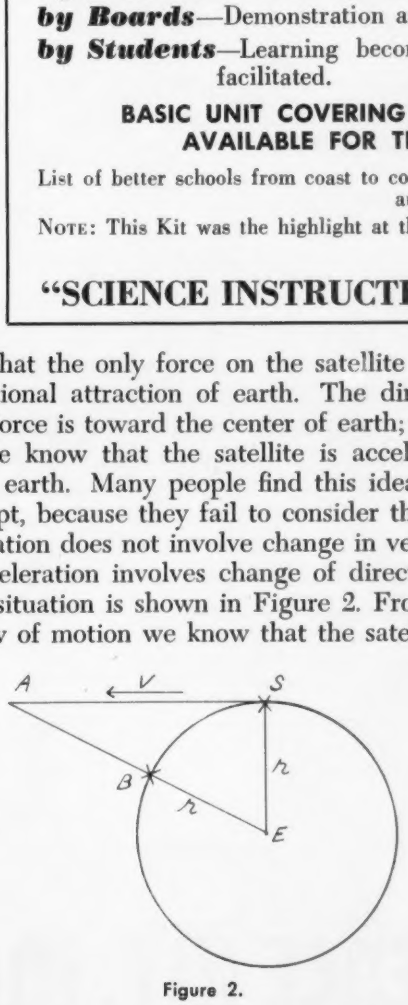


Figure 2.

trying to move in a straight line—*SA*. In the time it takes the satellite to go from S to *A*, gravitational force accelerates S toward *E*, pulling S away from a straight line. The amount that S falls toward *E* in this time interval is shown by the line *AB*. As a result, S moves along the curve *SB*. If the velocity *V* and the radius *r* are combined correctly, then the distance that the satellite falls will be just enough so the distances *ES* and *EB* will equal the radius of a circle. If the distance of fall in a given time interval is just right, the orbit of the satellite will be circular. In reality, the orbits of satellites are elliptical.

The situation which at first appearance seems paradoxical is explained quite simply; the force exerted on the satellite is unbalanced. This force causes the satellite to move away from a straight line. The satellite falls toward earth constantly.

In an identical fashion, the moon stays in orbit around earth because of an unbalanced force—the gravitational attraction of earth. This force accelerates the moon toward earth. It falls toward earth one-nineteenth of an inch each second. Also, earth stays in orbit around the sun because sun's gravitational attraction accelerates earth. This force changes direction of earth's motion, causing it to fall toward the sun one-eighth of an inch each second.

Note: This explanation is adapted with the permission of Dimitri M. Mihalas, author of a similar article which appeared in Griffith Observer for January 1959.

New Dimension For the Microscope

By GEORGE CONDIKE
Professor of Chemistry

and FRANK E. WOLF
Professor of Biology

State Teachers College, Fitchburg, Massachusetts

THE use of polarized light in working with a microscope is not new. There is not a great deal published, however, concerning the ways in which polarized light may be used and its functions in teaching biology, chemistry, physics, general science, and mineralogy.

The purposes of this article are: to explore ways of converting an ordinary teaching microscope into a polariscope, to indicate some functions of polarized light in science teaching with the microscope, and to share with my fellow teachers an original idea for making an inexpensive rotating stage for use in crystallography and chemical analysis.

There are several ways to convert a standard microscope into a polariscope. A pair of two-inch squares of Polaroid film may be purchased for $1.20 from commercial supply houses. These squares will be sufficient to equip two microscopes. Cut a circle of Polaroid film to fit the substage condenser filter ring. Cut a small rectangle of film just small enough to fit inside the upper section of the ocular and large enough to cover the hole in the flange inside the ocular. With an applicator stick, apply small drops of rubber cement to the corners of the Polaroid rectangle; and with a forceps, place the film inside the ocular to rest on the flange.

The microscope may be tilted without the film moving, yet the film may be removed easily when desired from either the ocular or substage condenser. The film in the substage condenser polarizes light and the film in the ocular analyzes it.

Another method utilizes a polarizing microscope filter kit (approximately $9), which has the film cut to fit any microscope and each piece of film is bound within a metal ring. The procedure for use is the same as for homemade rings.

A third method of making a polariscope is with Ahrens polarizer and analyzer attachments. These may be purchased from commercial supply houses. Although higher in price, the Ahrens attachments are not affected by heat and are suitable for a more permanent conversion of the microscope. These attachments fit into the substage condenser and the microscope body tube.

In professional practice, the specimen to be observed is rotated on a revolving stage. The third section of this paper deals with the construction of a revolving stage. In practice without a rotating stage, the specimen may be left stationary on the stage and the ocular rotated.

It is wise, in the following procedures, to use light sources with a minimum amount of heat because the film may be affected by heat. The teacher may prefer to use Polaroid *glass* polarizer and analyzer or to introduce Aklo heat-absorbing glass to protect the Polaroid film.

Polarized light has many uses in science teaching; following are some of its uses with the microscope. It is hoped that science teachers who know other functions of polarized light will present articles for publication also.

Procedures

Cut a hair into several quarter-inch sections. Place hairs in a drop of water on a glass slide and observe with the polariscope beautiful colors displayed by ordinary hair.

Cut a small section from the folded end of a cellophane wrapper from a cigarette pack. Place under the polariscope and observe different fields as the ocular is rotated.

Cut a piece of Lucite, approximately one by three inches, into a V shape.

Place the section marked "x" under the polariscope. Squeeze the open ends of the V and observe stress patterns.

Lay sections of mica on the stage of the polariscope and observe as the mica sections are moved about. Interference patterns are useful in mineral identification.

Use a colloidal suspension to polarize light with the substage film removed. Rotate the ocular to analyze the light and study the properties of different colloids.

Use nickel sulfate, boric acid, or magnesium sulfate in the following demonstration. Dissolve a small amount of the material in a few drops of water. Place a drop of the clear liquid on a glass slide and observe under the polariscope. Study the edge of the drop as the water evaporates.

In the nickel sulfate solution, a ring of crystals will be seen forming at the periphery of the drop, early in the evaporation process. As the water evaporates, palisade-type crystals will form perpendicular to the outer ring. In the boric acid drop, beautiful, tiny crystals form throughout the drop. As the ocular is rotated, truly magnificent colors are produced, which add a new dimension to the microscope.

Other recommended crystals are: benzoic acid, aspirin, potassium nitrate, borax, sugar,[1] and tartaric acid, sodium thiosulfate, and potassium chlorate.[2]

Recrystallize naphthalene [3] from its alcoholic solution in a small drop on a slide under the polariscope.

Make a very thin section of a fresh potato and study starch granules under the polariscope.[4]

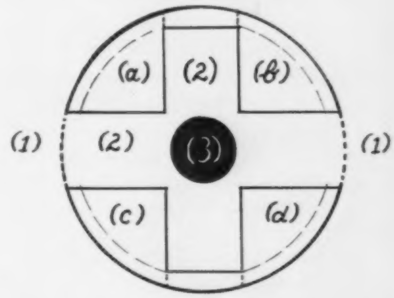
Observe stress patterns in glass, compressed or put under strain by heating and cooling.[5]

In the preceding work, it has been necessary to rotate the ocular to achieve the desired results. In actual practice, however, the specimen is rotated between fixed Polaroid films. Unfortunately, the average science classroom cannot afford a chemist's polarizing microscope, costing between $650 and $1600, which permits rotating the specimen.

Soon, there will be available an inexpensive, universal, attachable rotating stage. The advantage of a rotating stage lies in the fact that the Polaroid can be set at any desired point and not disturbed while the specimen is rotated. The specimen is rotated on its own axis through a plane of polarization at any given point from extinction. This arrangement permits measurement of the degree to which the plane of polarization varies from extinction on the axis of polarization of the specimen.

For the benefit of those who may wish to make a rotating stage themselves, the following plans are offered.

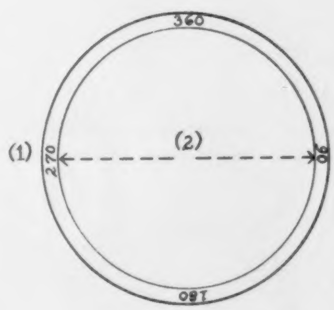
Secure three pieces of plastic approximately the size of the microscope stage. One of these pieces will be called the *base;* another the *collar;* and the third, the *rotating disc*. A fourth, smaller and thinner piece is called the *Polaroid carrier*.



BASE

To form the base, cut a piece of plastic, making a circle approximately five inches in diameter; the thickness of the piece is between one-eighth and one-quarter inch. Bore a hole in the center of the base the same size as the light opening in the microscope stage.

Cut four wedged-shaped sections as indicated by A, B, C, and D above and cement to base. These wedges will form a channel for a slide-type Polaroid carrier. The dotted lines, numbered 1 above, provide openings for the carrier arms. The cross-shaped area, numbered 2 above, provides a channel for the carrier. Number 3 above represents a hole.



COLLAR

To form the collar, cut another piece of plastic making a circle the diameter of which is the same as the base. The collar will consist of a ring approximately five sixteenths in width, with a large opening approximately four and three quarter inches in

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[1] John Richardson and G. P. Cahoon. *Methods and Materials for Teaching General and Physical Science.* McGraw-Hill Book Co., New York. 1951, p. 89.

[2] *Ibid.*, p. 377.

[3] *Ibid.*, p. 377.

[4] *Ibid.*, p. 376.

[5] *Ibid.*, p. 378.

diameter. The thickness should be slightly less than that of the base. A three hundred and sixty degree scale may be drawn on paper and glued to the collar. The inside of the collar should be quite smooth. Number one above refers to the degree scale which may be numbered every ten degrees and have single degree markers in between. Number 2 represents the diameter of the opening in the collar.

The commercially available stage may have a set screw through the collar to hold the rotating disc and a thumb screw with gear teeth to rotate the disc.

ROTATING DISC

To form the rotating disc, cut the third piece of plastic to fit closely inside the collar. The disc should protrude above the level of the collar so that a slide placed on the disc will clear the collar when rotated.

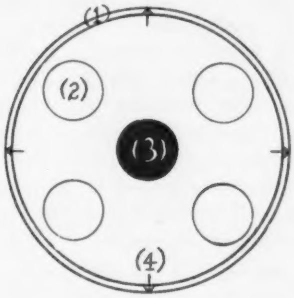
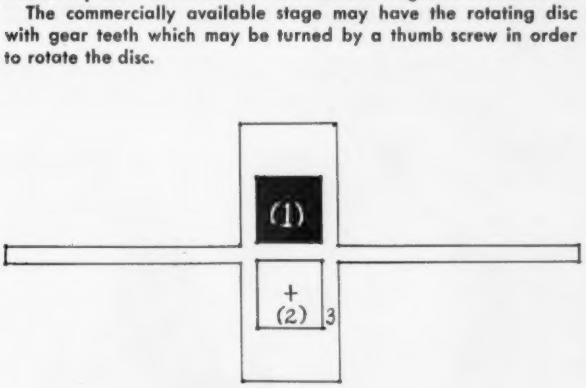


Figure (1) above refers to a slight bevel which will allow the pointers, indicated by the arrows, to approximate the degree scale on the collar. Figure (2) above represents four shallow depressions for the fingers, which aid in revolving the disc. (3) above represents a hole bored through the disc. Number (4) above represents markers with which the degree scale is read.

The commercially available stage may have the rotating disc with gear teeth which may be turned by a thumb screw in order to rotate the disc.



POLAROID CARRIER

The Polaroid carrier is formed in the shape illustrated above with two square openings indicated by numbers (1) and (2). The plastic should be thinner than the four wedges since the carrier will slide freely in the grooves provided by the wedges and yet not be inhibited in its movement by the rotating disc which lies over it.

Number (1) above represents Polaroid film with a small marker to indicate plane of polarization. The Polaroid that will fit into the ocular will have a similar marker so that by rotating the ocular and aligning the two markers a point of extinction can be accurately reached. Number (2) above refers to a clear glass or plastic film with centered cross hairs which will be used to center the specimen being observed.

The Polaroid carrier may be flat with the Polaroid or clear plastic cemented to the edge of the square openings; or, there may be a channel, represented by number 3, around the inside perimeter into which the Polaroid and clear plastic may be dropped.

The collar is bonded to the base. Acetone is a good bonding agent for acetates; glacial acetic acid works well with Plexiglass or Lucite; zylene works well with other kinds of plastic; ethylene dichloride works well with most plastics.

To hold the rotating stage in place, use a pair of alligator clamps over the stage of the microscope and edge of the base of the rotating stage at points opposite the arm and at the arm base.

The Polaroid carrier may be omitted in which case the Polaroid would be removed from the substage condenser if unpolarized light were desired. If the carrier is omitted, it will not be necessary to use the four wedges in the base.

In operation, the carrier arms would be moved so that the clear plastic film covers the opening. The specimen would be centered on the cross hairs and then the Polaroid section of the carrier would be moved into place. The ocular would then be rotated until the hairline marker is aligned with the marker on the Polaroid which is in the carrier.

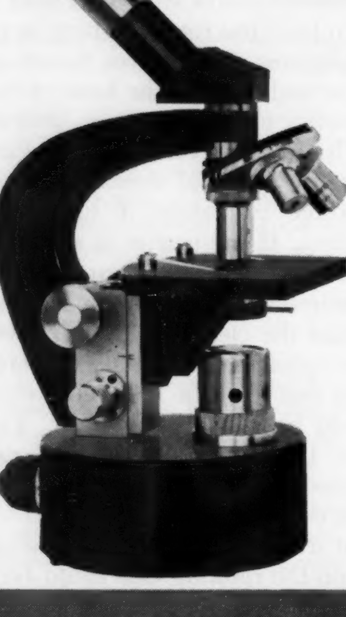
In studying crystals, any one of the four pointers on the rotating disc could be read; then after the specimen is rotated to its desired position a second reading could be made. The difference between the two readings would indicate the degrees from zero for that specimen.

It may be that the commercially available product will have incorporated into it a system to warm the stage, thereby speeding up the evaporation process for crystal study.

These procedures are simple enough to include in any teaching unit or course of study.

UNITRON student microscopes offer

UNITRON STUDENT AUTO-ILLUMINATION MICROSCOPE, MSA



The UNITRON Student Auto-Illumination Microscope, Model MSA, employs a newly designed stand in which all components and controls are within easy reach. The inclined eyepiece tube allows comfortable posture and may be turned in any optional observing direction to permit two students sitting side by side to share a single instrument. With the built-in illuminating system of the superior low-voltage type, each student is assured of the correct lighting. The transformer is conveniently housed in the microscope base itself where it contributes to the stability of the stand rather than to the clutter of the laboratory table.

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UNITRON STUDENT MICROSCOPE, MUS

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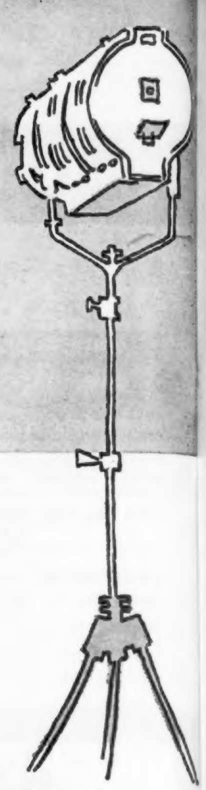
SPOTLIGHT on RESEARCH



Classroom Action Research

By JOHN G. READ

Professor of Education, Boston University, Massachusetts

WHAT do science teachers know *for sure?* The answer to this cracker-barrel philosopher's question was, and is, "Not a durn thing." We science teachers have to answer in the same way when we ask ourselves many questions about our purposes, our programs, and our pupils. Individually and then collectively (given adequate communication among teachers through NSTA), classroom action research[1] can answer some questions all of us have been asking.

We can start in our own classrooms and work up to some problems which can best be solved on a national scale, although they too will be done bit by bit in a thousand classrooms, one of which is ours. The following sections describe classroom action research projects you can try.

1. In any given science area, the one which you are currently about to teach: what have been *the common environmental experiences* of your pupils? Start with telling, orally or through free writing, the experiences, say in air pressure. Let a committee of able boys and girls tabulate these experiences on a 3 x 5 card.

The cards make up a list which is duplicated and read to the whole class without much discussion, except as to whether all of these belong to the same *set* of experiences. Then the class adds new out-of-classroom experiences to the file. Teaching is done to bring everyone up to that common learning level which we think is suitable for the grade. From year to year you can see strengths and weaknesses of incoming groups.

I saw or felt	*I got second-hand information*
air pressure numbers on car and truck tires	T—natives from Peru with big chests and lungs
a barometer at home	M—a tire that blew out in Denver, Colorado
an experiment in third grade with a can that wrinkled up	TV—a man who with his breath, blew up an inner tube until it broke.
a mercury barometer at the Weather Bureau	(M—"I heard this by word of mouth
	T—I saw a picture or it was in type
I felt my ears hurt coming down in a plane	TV—television)

2. Alfred Korzybski, in his book, *Science and Sanity,*[2] shows clearly that most of us think and act as if words were almost as real as the thinks they can but vaguely represent. It is our own experiences which give them color and bias. They often stir our deepest emotions. Good science teaching can help to put words in their proper places—as starting points and guide posts for investigation of science methods.

Here are some concept-loaded word groups which often appear in science discussions, yet which slide by without check. It is possible to plan to have them come up as a result of experiments or other experiences conducted in the classroom. And then keep an anectodal record

[1] Stephen M. Corey. "Action Research to Improve School Practices." Bureau of Publications, Teachers College, Columbia University, New York. 1953.

[2] Alfred Korzybski. *Science and Sanity.* The Science Press Printing Company, Lancaster, Pennsylvania. 1933.

of how each discussion comes out.

—it has to be true, it was in the book
—he was the first one to do it
—these are exactly alike
—it won't work
—my grandma says so
—you didn't do that right
—we always do it that way
—that was the cause of the result
—all of them are like that
—it never happens
—you can't do that

Perhaps the first step would be to discuss with our class whether we should discuss these in class! Here is where ethical and authoritarian considerations are evaluated. *Specific instances* are the way to reaching agreement as to what the group believes. For instance, should we take grandma's word, or should we go to the doctor for treatment—if grandma wants to use a boiled-onion poultice for an earache? A real problem here, especially when the onion works fine!

3. What are the misconceptions, *not* superstitions, in science which cripple your pupils' minds as they become young adults? William P. Rogers[3] did a nation-wide study on this. He found that more than fifty per cent of boys and girls believed in these misconceptions, among many, which had been said to be important for the behavior of pupils in grades nine and ten:

Cream is lighter than milk.
Smoke always settles before a storm.
Red-haired women are hot tempered.
A rattlesnake always warns before he strikes.

Just putting out the fires which rage through pupils' behaviors because of their holding of many misconceptions could be a full-time science program. By testing those misconceptions which can be investigated experimentally in the classroom, through observation and through actual demonstration (cream can be shown to be lighter than milk using the half-pint containers which both come in and with an equal-arm balance made of a yardstick), a state of *gentle skepticism* can be engendered. The item about red-haired women might be checked by children's opinions of their own or other mothers! But if smoke *sometimes* sinks, sometimes rises, just before a storm, the "not enough evidence" decision is good science method.

4. Finally, and this is a sort of scrap-bin of suggestions much like the real bin which every teacher has, into which he puts everything small and presently useless, and from which he takes vital and unique materials a little later that are just the thing to demonstrate a science principle.

Editor's Note: This series of articles has been prepared for TST by NSTA's Committee on Research under the Chairmanship of Dr. William B. Reiner, Board of Education of the City of New York. It is planned to continue the series during 1959-60.

a. If you get your class ready for a one-day camping experience, complete with charts, costs of food, need for transportation, roadside items of interest as you travel, safety and first aid measure, diets and toilet faciilties, will there appear a real helping hand from parents, administration, and landowners? Will the *research* make the *search* easier and will it make the *action* a reality? This is sort of a research into research. Here is a clue. No one can resist an enthusiastic group of children who have made careful plans to go on an adventure!

b. What effect will pupil-teacher-made problem-solving laboratory guide sheets have on interest and academic success in the chemistry laboratory? And what would a modest series of personal laboratory experiences planned cooperatively have on general science pupils who have had no laboratory? Just look out that you are not run over by the drive and enthusiasm of pupils who have been placed in such situations. On any standard test, on interest inventories which the teacher and pupils make together, or on tests of problem-solving abilities, there might be a heart-warming change. Don't forget to report your results in short articles so that others can give replication to your work.

c. Can selected, planned, science fiction reading help critically to evaluate our present technology? Read some of the better science fiction and see if there are make-believe situations which are close correlates of present-day problems in science, which touches on human welfare. One or two stories could stimulate critical evaluation of labor, of technology, and of values that are needed or are being lost in our modern science world. Very short science fiction stories written by individuals or groups of high school science pupils might make the pages of national magazines. They surely could be the theme for an issue of your school's "Science News."

d. What are some "permanent products," science facts, or principles left from teaching which has gone before? Can you count on their being known by almost all of the pupils of your incoming classes? Do they know about living cells? Have they a picture of the molecular structure of matter? What is their image of an electric current? If we could establish just the bare minimum of certain residues, grade by grade, we would be far ahead of the present situations, where there is little agreement on grade placement of facts and principles of science. There is a strong possibility that the normal pupil, in *any*

[3] William P. Rogers. "A Determination of the Prevalence of Certain Important General Science Misconceptions." Unpublished doctoral dissertation, Boston University School of Education, Massachusetts. 1956.

environment in this country, will acquire with or without the aid of the school, certain science facts and understandings. This common environmental background is not known to text and test writers, nor to most teachers even for their own towns or cities. Consequently we teach and reteach much material which is already known to most pupils in the group; and about which, the quiet little mice, they say nothing! Reporting of such research would advance the art of science teaching by many years.

Every partial answer we can get to the questions posed above often stimulates further classroom activities which yield more information about how children and young adults can learn sciences better and can be better citizens in the unknown world of the future.

Leake . . . from page 222

This is a time of crisis. It is a new renaissance. It is a period of confusion and of tension, in the readjustment of our sense of values to the new knowledge we have. Can we guide ourselves into a new era of enlightenment? Can we preserve our individual freedoms in mutual compromise toward social welfare?

The answers that all of us want to these tough questions can come, if we all work for them. Science teaching is not merely a matter for youngsters; adults and oldsters may profit from it also. Science continues always to add to our store of positive verifiable information about the universe, including ourselves. We all have a real responsibility to keep up with scientific advance, if we expect to profit from it.

Our science teachers have a key position of trust and responsibility in our common cultural effort. From the clear record of their achievement, now applauded in every state, we the people know that they will hold to that position with honor. We the people can best show our appreciation by giving our science teachers the social prestige they so well deserve. Then surely we will have enough science teachers to take care of the growing hordes of youngsters eager to learn about themselves and their world. Part of our job will be to inspire them to continue that learning throughout their lives.

We, the people, salute you, devoted teachers of our precious science. We know that you are well molding and fashioning the plasticities of our youngsters, who now, in *the palms of your hands,* will soon be going forth to maintain the standards of our culture.

Pella-Raasch . . . from page 235

10. The sun is a ball of gases.
11. The sun is made mostly of hydrogen and helium.
12. The sun has prominences.
13. Gravity pushes the sun in and pressure pushes it out.
14. If it were hollow, more than a million earths could fit inside the sun.
15. It has sunspots.
16. The sunspots look like tornados.
17. The sunspots are larger than the earth.
18. Sunspots go in eleven-year cycles.
19. Sunspots affect radios and communication systems.
20. The sun will shine for millions of years.
21. The sun is in the yellow stage now; the blue stage would be next.
22. Ancient people worshipped the sun.
23. The sun makes solar cookers work.
24. A solar cooker can be made from a curved mirror.
25. The focal point is the hottest point of reflection.
26. Shiny things reflect the sun.
27. Black things absorb heat better than light colored things.
28. The solar cell gives just a little power.
29. The solar cell is made of silicon which comes from sand.
30. The solar battery can be used to operate telephones.
31. Storage batteries are used on cloudy days to supply power for the telephones.
32. Solar batteries are used in some soldiers' helmet radios.
33. Chlorella is a seaweed; it is a kind of algae.
34. Chlorella is all edible.
35. Chlorella is used in a kind of flour which then is green.
36. Our sources of food depend on the sun.
37. The sun helps plants grow.
38. The heat of the sun causes water to evaporate and form rain clouds. Without rain there could be no water power so water power is really sunpower.
39. The sun's heat is the cause of winds which do work for us.
40. Solar houses have lots of windows.
41. Solar houses usually have most windows facing south.
42. In winter more sun gets into solar houses because the sun is lower in the sky.
43. The heat of the sun is trapped by the windows.
44. Some solar houses have concrete floors for radiant heating, too.
45. Some solar houses store the heat in a water tank.

46. Coal to feed engines comes from the sun. It is decayed plants that had grown millions of years ago.
47. Coal, gas, and oil are buried sunshine.
48. Inside the greenhouse it is much warmer than outside because the heat is trapped by the glass.
49. A magnifying glass can focus light to a point; it can start a fire.
50. Never look at the sun with bare eyes; use smoked lenses.
51. Moonshine is really reflected sunshine.
52. There is an eclipse of the sun when the moon is between the earth and the sun, and cuts off the light of the sun.
53. The sun's corona is not always the same.
54. Photosynthesis means putting together with light.

The ideas about the sun expressed by the pupils before studying the unit were rather simple and limited in number (only 26). Only one of the ideas listed in Table I mentions the word solar and this was in connection with the solar system. The ideas expressed in Table I were concerned mainly with the size, shape, heat, and light effects of the sun on the earth.

At the completion of the study the number of ideas more than doubled (54) and they were more concerned with the sun as a source of power.

Conclusions

1. Third-grade pupils are interested in solar energy.
2. Both boys and girls were interested and took part in all activities in the unit.
3. The increase in number and complexity of the statements given by pupils before the study of the unit compared with that after the study of the unit indicates that learning had taken place.
4. Materials are available at the reading level of third-grade pupils on the topic of solar energy.
5. Parents of the children were interested in this unit as indicated by the fact that they participated and provided equipment. Children asked for copies of materials to take to their parents.
6. Children requested the titles of other books so that they could buy or borrow them for further reading.
7. Through organized instruction third-grade pupils can learn many new and interesting things about solar energy.

Classroom Ideas

Physics

Ohm's Law

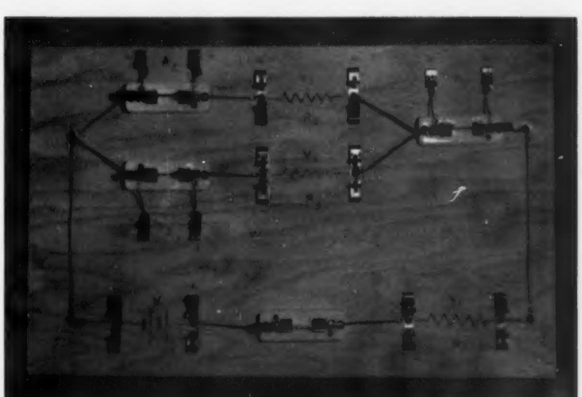
By ARTHUR G. SUHR, Jefferson High School, Jefferson, Wisconsin

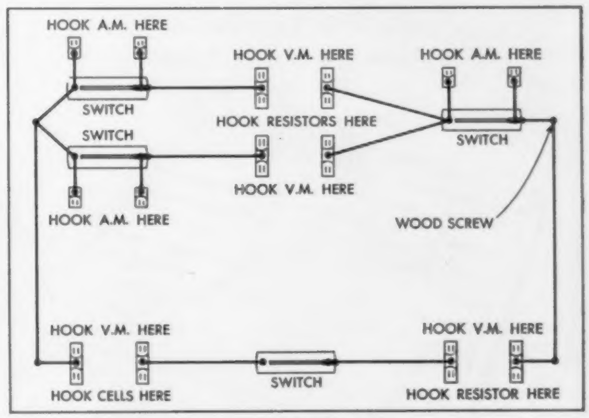
The photo and diagram illustrate a wired board which has been used to teach *Ohm's Law* to students. This device may be used either for demonstration or as an individual work project.

The common laboratory exercise on "Divided Circuits" makes use of a wired board as the one illustrated. The board eliminates much of the wiring and need for a large number of meters. Clips are provided for hooking in the various components. The switches provide an easy method of placing an ammeter in the circuit. When students are shown that the switches must be opened to obtain a true reading of the ammeters, they can readily grasp the meaning of "shunt."

If resistance boxes or accurate resistors of known value are used in the circuit, students can compute beforehand the expected values of the meter readings. The students may then prove experimentally the calculated results with more accuracy and understanding.

Most of the parts for this project may be found in any laboratory, but if not, the models may be constructed for less than two dollars.





SINGLE CLIPS AT EACH SWITCH
DOUBLE CLIPS AT OTHER JUNCTIONS
MOUNTED ON 3/4" PLYWOOD 14" X 20"

A Simple Inexpensive Geiger Counter

By JAMES WAHLA, Roseville, Michigan

THE RECENT DEVELOPMENT of high voltage batteries and cheaper G-M tubes has made it possible to build a good Geiger counter for about \$15.00. This is not a toy like some now available in this price range, but an instrument as sensitive as those costing many times its price. It has the advantage of requiring only a few parts and these are relatively rugged compared to those of the complex and expensive vibrator-vacuum tube circuits.

Any 900-volt Geiger tube may be used. Those easiest to obtain include the Raytheon CK 1026 (\$3.35), the Victoreen IB85 (\$7.50), and the Amprex 75N (\$10.00). The CK 1026 is a good choice because it is a handy size and shape and is readily available from most radio parts companies. In mounting *any* G-M tube the outside shell should have the negative potential. The life of a tube is several thousand hours, so that replacement is seldom necessary. [Prices quoted are for 1958.]

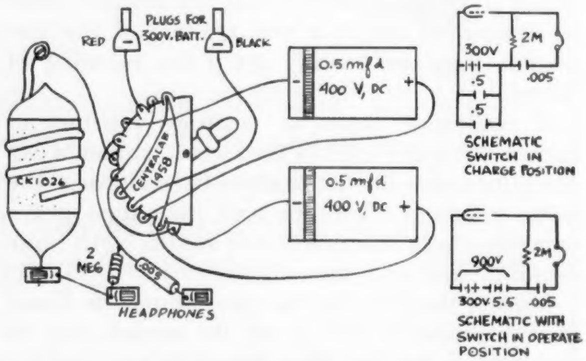
One 300-volt battery is used to operate the 900-volt G-M tube with the help of two common radio condensers. The two condensers are connected in

parallel with the battery at one switch position to charge them and changed into series with the battery at the other (see diagram). The two condensers, charged with 300 volts each, plus the battery gives us the 900 volts we need. The larger the value of the condenser the longer the charge will last. Current drain is very low.

A .5 or .25 MFD is large enough to operate the counter up to a half an hour. Momentarily changing the switch position will re-charge them when they run down. Because 600 working voltage condensers are necessary, paper capacitors are best from the standpoint of size and price. In wiring, polarity *must* be observed.

Because the high voltage and polarity of the battery, capacitors and G-M tube must all be reckoned with in the complex switching from parallel to series it is important that the right switch be used and connections be made as shown. The use of another brand of switch may change the wiring entirely. Just comparing the two shown will illustrate this point.

To prevent shocks the counter should be housed in a plastic box such as an index card file box from the dime store. A metal box is not a good substitute. The 900 volts should be treated with respect and insulated properly.



Notice in the tube-mounting diagram that the bolts which carry the high voltage do not go through to the outside of the box. The wiring must be done with high voltage *insulated* wire to prevent "flashing." Because the 300-volt battery delivers a shock more severe than your 110-volt house current, it is not wise to probe around in the circuit without first disconnecting the battery and grounding the condenser charge.

Substituting an .001 condenser for the .005 will reduce the volume if necessary. The value of the Z-meg resistor is not critical either. A 1.8 meg works just as well. Other near values work just as well, so use whatever you find in a junk box or old radio if it is close. I found an army surplus

radio for 30¢ that furnished the condensers, resistor, high voltage wire, and mounting hardware for building the counter and saved some money. You might try the same thing. There is no on-off switch used because when the capacitor charge has run down the circuit no longer draws current. The battery will last almost as long in this circuit as it would lying unused.

To use the counter, flip the switch to the parallel or charge position and then to the series position. Background clicks will be heard every 15 seconds or so. A radium dial clock or watch brought near the tube will change the clicks to a steady crackle like frying eggs. Atomic radiation goes through the plastic case so easily that it is not necessary to drill holes near the tube. Indeed the whole instrument might better be sealed from dirt and moisture.

A neon light may be added to the circuit but does not give enough light to be much good for classroom use. To amplify the sound for classroom demonstrations try hooking the output of the counter to the crystal phono input of a radio.

Your chances of finding a valuable radioactive deposit even with a Geiger counter are slight. Most areas near highways, roads, and trails have already been checked but if you just want some of the rare radioactive minerals in specimen size quantities don't give up hope. Road cuts especially those in granite pegmatite areas often have pieces of uranite, euxanite, or some pitchblende exposed. I have collected from road cuts in the Gravenhurst, Ont., area and understand parts of New York State and New England are even better for this type of thing. Look for small black bits of rock surrounded with a "web" of cracks. This radial shattering is caused by radioactivity. Check it with your counter to be sure it is radioactive and some work with a hammer and chisel will add it to your collection.

Biology

Earthworm Model

By JOSEPH T. FRANK, Eastside High School, Paterson, New Jersey

Some rather simple materials can be put together to make a model illustrating the body plan of an earthworm. (See diagram next page.)

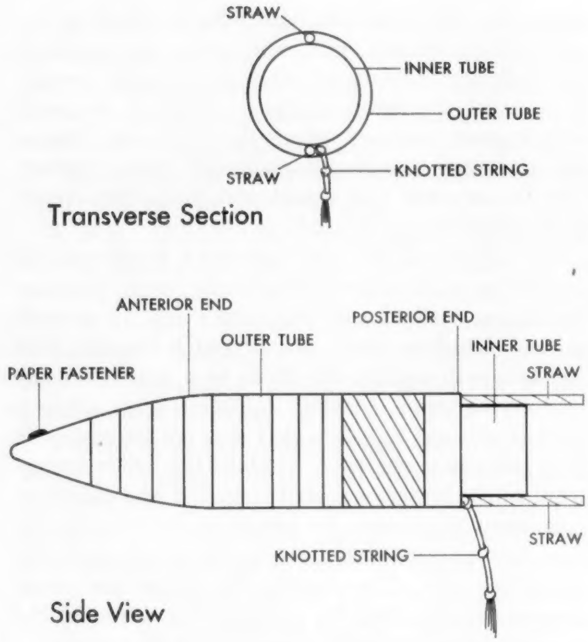
Materials needed:

1. Two empty cardboard cylinders, one slightly larger than the other, such as an empty tube from waxed paper, or aluminum foil.
2. Two long soda straws.
3. One 12-inch piece of knotted string.

4. Two paper fasteners.
5. Crayon and scotch tape.

Procedure:

1. Take the larger of the 2 tubes and scotch tape the knotted piece of string inside of the tube, allowing about 2 inches to hang freely from one end of the tube. This will represent the ventral nerve cord.
2. Now scotch tape one of the long straws over the string in the tube. Allow this straw to protrude posteriorly from the tube some 3 inches. You may color it red if you wish; this represents the ventral blood vessel.
3. Scotch tape the other straw to the inside wall of the tube, opposite from where the first straw was placed. Permit this tube to protrude some 3 inches. This will represent the dorsal blood vessel.
4. Now insert a smaller cardboard tube into the longer tube allowing it to protrude posteriorly about an inch and a half. This may be scotch taped to the longer tube by working from the other end. This will prevent it from sliding out.
5. Squeeze flat, the anterior end of the large tube. This may be held together by 2



paper fasteners. This portion will represent the head end of the earthworm.

6. With crayon shade in a wide band for a clitellum and make circular lines for the segments.

GRASS SEED for experiments

By HARPER FOLLANSBEE

Biology Department, Phillips Academy, Andover, Massachusetts

This report was an entry in the 1957-58 STAR (Science Teacher Achievement Recognition) awards program conducted by NSTA and sponsored by the National Cancer Institute, U. S. Public Health Service.

ALTHOUGH many types of living material are available from supply houses and an abundance is available from nature, the teacher may not always have an adequate budget to buy material, or time to collect it.

With ten-cents worth of grass seed, one can easily provide a great deal of material for interesting laboratory study. Initial preparation requires about five minutes and, commencing approximately one week later and continuing for a period of several weeks thereafter, the material furnishes an abundance of interesting study subjects. The technique is simple and probably not new to science teachers.

Fill a 2000 ml beaker with water. Lightly sprinkle grass seed on the surface until it is completely covered. Place the beaker either on a window sill or in strong diffuse light. Care should be taken while transporting the beaker not to jar it suddenly and cause the seed to sink below the surface. There is considerable latitude in the requirements. In this area, we use water straight from the tap. In areas where the water is heavily treated, it might be advisable to substitute distilled water. The size and shape of the container is not at all critical. Culture dishes of approximately four inches diameter and two-inch depth serve just as well and have advantages which will be mentioned later. There is no reason why a peanut butter jar would not serve.

In approximately one week, the seed will have germinated and produced primary roots one half to one inch in length. The seed of any fast-growing grass should produce these results but it may be advisable to pre-test the seed if an exact time for use is necessary.

Germination of the seed in itself demonstrates several points. Students observe that soil is not necessary for germination. Should they wish to check the effect of light on germination, a container of seed can easily be placed in a warm, dark closet. A strong light, placed in such a position as to shine through the beaker beneath the surface of the water, will reveal the multitude of root hairs growing from the grass roots.

Slides of the roots make excellent subjects for study. Single roots may be obtained by grasping a blade of grass with a forceps and carefully lifting the plant from the water. If ungerminated seeds or seed coats adhere to the root as it is lifted out, these may be rinsed off by holding the plant under gently running water from the tap. Using scissors, cut the lower half to three quarters of an inch of root from the plant, dropping it into a drop of water on a slide as it is cut. (The tip of the root may be held in the drop of water, while cutting, to facilitate getting it onto the slide properly.) Place a cover glass over the

Figure 1.

mount and the root is ready for study. Seed grown in the 2000 ml beaker or in the culture dish mentioned above will furnish more than sufficient roots for 150 students.

At a magnification of 50X, the gross structure of the young root may readily be observed (Figure 1). Root cap cells and root hairs are prominent. In Figure 1, the thickness of the whole mount results in blackness of the root cells in a photographic exposure showing the root cap cells and root hairs. In visual observation, cellular structure of the root may readily be observed.

Increasing the magnification to 100X reveals greater detail. At the very tip of the root, the large, protective cells of the root cap display prominent nuclei. In general, students have no difficulty locating approximately the Meristematic Region, Region of Cell Elongation, and Region of Cell Maturation.[1] Cells of the Meristematic Region tend to be small, closely packed, and cubical in shape. Differentiation between these and the elongating cells directly above may readily be made. Presence of root hairs and the beginning of the vascular cylinder clearly mark the Region of Maturation. In this latter region, epidermis, cortex, and vascular cylinder are identifiable. Students trained in close observation will be able to observe cytoplasmic streaming in the root hairs. A switch to the high power (4mm or 44X) objective is rewarding. Even the most unobservant student cannot fail to note the streaming action. Vacuoles and other cytoplasmic inclusions are conspicuous (Figure 2). In fact, this is the most reliable source of material for observing this activity that the writer has been able to find. Students will have no difficulty in determining that the root hair is an elongation of an epidermal cell for they can observe the origin of the root hair from its base by examining epidermal cells at the edge of the mount (Figure 3).

Examination of the vascular cylinder ordinarily reveals mature xylem vessels with pitted walls (Figure 4). Students may or may not need assistance in identifying these.

If one follows the root upward through the Region of Maturation, young lateral roots may often be observed. This is most readily done under a magnification of 100X. Once located, the lateral root may be observed both under this magnification and also under the high power objective. The endogenous origin of the lateral root in deep tissue (in contrast to the origin of lateral branches) is apparent, as is its growth through the cortex (Figure 5).

Such observation of the young root leads very nicely to a discussion of the physiology of the root and its importance to the plant. Particularly noteworthy are the roles of the meristem and the root hairs. It should be noted that the latter, so obvious in their abundance on these young roots, are ordinarily confined to a region between one and several centimeters in length near the tip. They are absent in the nearest proximity of the apical meristem, and they die off in the older root parts.[2] As the older root hairs die off, new root hairs continue to be produced at the lower end of the zone so that the total number of root hairs remains fairly constant. The common interpretation of the function of the root hairs is that they increase greatly the absorbing surface of the root. Since ordinarily there is limited capillary movement of water in soils toward roots,[3] the importance of the apical meristem in growing into new areas of soil with greater water and mineral content becomes obvious.

[1] An excellent general account of the structure and physiology of the young root will be found in Chapter 9 of reference (1). More complete coverage is found in Chapters 4, 5, and 17 of reference (2).

[2] Reference (2), page 475.
[3] Reference (1), page 183.
[4] Reference (1), page 183.

Figure 2.

Figure 3.

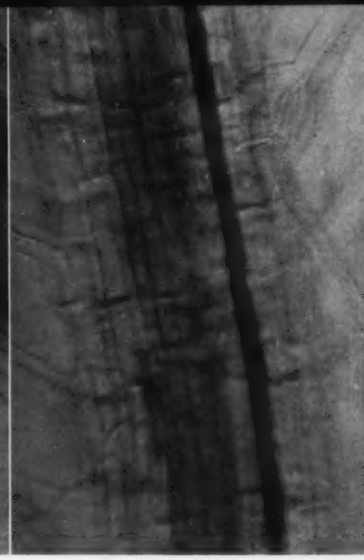


Figure 4.

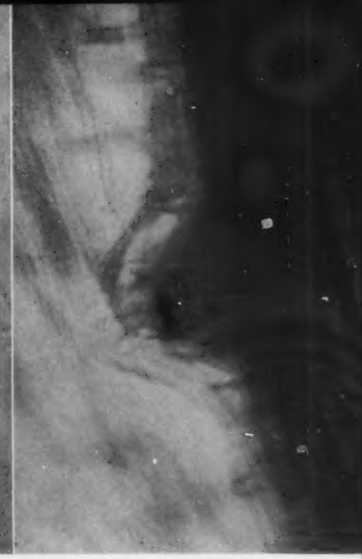


Figure 5.

When one considers the profusion of these root hairs at the tip of the root together with the tremendous abundance of lateral roots (each of which has its own root hair zone) in some root systems, he begins to appreciate their importance in terms of absorption to the plant. ". . . in a rye plant, for example, more than 14 billion root hairs with a total length of about 6600 feet and a surface of 4321 square feet are present." [4] The significance of maintaining a relatively large area of the root system with the surrounding soil intact and undisturbed during transplanting takes on greater meaning for the student.

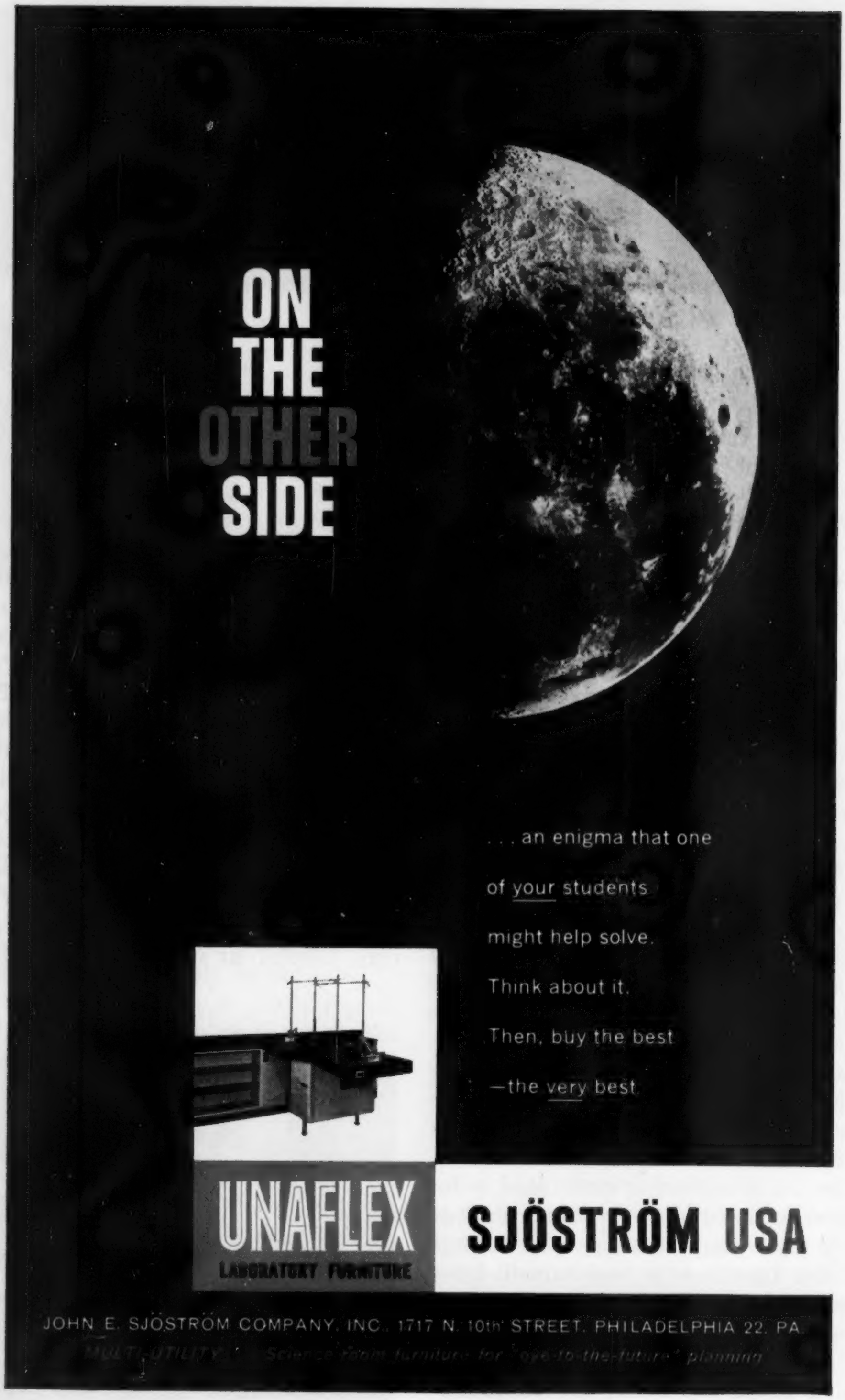
Further discussion of the root may well bring up the question of tissue differentiation and growth integration. An interesting and simplified discussion of these problems is to be found in Chapter 19, pages 443-447 and Chapter 15, pages 336-342 respectively of reference (3). Interesting experiments with root growth hormones along the lines indicated in the reference may be performed by students. Expenses involved are slight and include primarily the cost of the seeds in addition to the hormones which are now available through supply houses. The cost of these supplies is warranted by the enthusiastic interest of students in this kind of experiment.

Valuable as the germinating grass seed is for its contribution to the study of root morphology and physiology, however, we are not yet through with it. If the container is maintained for a period of two to three more weeks, it commonly becomes the source of an abundance of microscopic life (shallow containers such as the culture bowl mentioned previously are frequently better from this standpoint than the beaker). Considerable evaporation may be allowed to occur. The main consideration is to prevent the container from going dry.

This is usually a dependable source of Vorticella (Figure 6) which appear about the same time as the roots are ready for study or a few days later and are commonly found attached to the roots themselves. The writer has depended on this source of Vorticella for student observation for quite a few years and has rarely been disappointed.

Somewhat later, numerous small ciliates appear and frequently Paramecia show up in large numbers (Figure 7). In addition, the writer has observed Stylonychia as well as many Rotifers. In the late stages, the infusion becomes a rich source of bacteria. Undoubtedly a student could make an interesting study of the "succession" of microscopic life to be found over a period of several weeks. References (5) and (6) would be very helpful to such a study. Many of these

Figure 6.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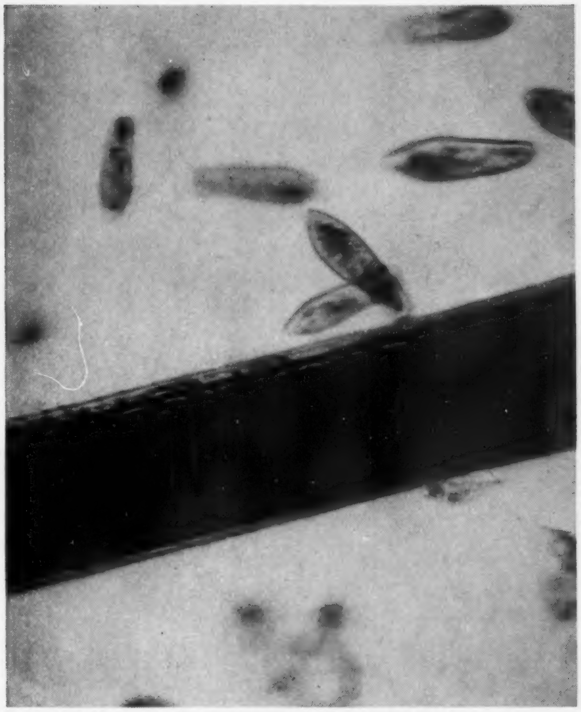

Figure 7.

microorganisms are readily cultured for future detailed observation.[5]

Thus, the expenditure of a few cents plus a few minutes of the teacher's time can result in a rich supply of laboratory materials.

References

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2. Katherine Esau. *Plant Anatomy.* John Wiley and Sons, Inc., New York. 1953.
3. James Bonner and Arthur W. Galston. *Principles of Plant Physiology.* W. H. Freeman and Co., San Francisco, California. 1952.
4. Paul S. Galtsoff, Frank E. Lutz, Paul S. Welch, and James G. Needham. *Culture Methods for Invertebrate Animals.* Comstock Publishing Co., Inc., Ithaca, New York. 1937.
5. T. L. Jahn and F. F. Jahn. *How To Know the Protozoa.* William C. Brown Co., Dubuque, Iowa. 1949.
6. Henry B. Ward and George C. Whipple. *Fresh-Water Biology.* John Wiley and Sons, Inc., New York. 1918.

[5] Reference (4).

NSTA Activities

1959 Summer Meeting

Here is the complete program for the NSTA annual summer meeting in St. Louis, Missouri. It will be held at the YMCA, 16th and Locust Street. All NSTA members in the region and others who may be attending the NEA summer meeting are cordially invited. Theme of the conference is "Growing Up with Science."

Wednesday, July 1

9:00 a.m. General Session. Big Gymnasium. *Presiding,* Elmer Headlee, Chairman of the Science Department, Kirkwood, Missouri, High School.

Address: "Growing Up with Science," Dr. Donald G. Decker, *President-Elect of NSTA;* Dean of the College, Colorado State College, Greeley.

10:00 a.m. Sectional Meetings.

1. Physical Science. Room 209. *Presiding,* Elmer Headlee.

"The Outer Fringes of the Periodic Table," Elmer Headlee.

"Physics Beyond the Classroom," Brother L. Charles, F.S.C., Chairman of the Science Department, Christian Brothers High School, Clayton, Missouri.

2. Biological Science. Room 302. *Presiding,* J. W. Galbreath, Chairman of the Science Department, East St. Louis, Illinois, High School.

"The Nature Area Development at the New East St. Louis High School," J. W. Galbreath.

"Wings for Biology Students," Joan Hunter, Chairman of the Science Department, Edwardsville, Illinois, High School.

3. Junior High School Science. East Room. *Presiding,* J. W. Knight, Science Instructor, St. Charles, Missouri, Junior High School.

"Spectographically, Why?" J. W. Knight.

"Biological Interest Catchers," Robert Gruenwald, Science Teacher, Woodward School, St. Louis.

4. Elementary Science. Big Gymnasium. *Presiding,* Donald G. Decker.

"Eyes To See," Eva H. McKee, Sixth Grade Teacher, McKinley School, Normandy, Missouri.

"Minds that Reach," Ruth Rice, Third Grade Gifted Children, Glenridge School, Clayton, Missouri.

12:00 Noon-2.00 p.m. Luncheon Session. Brown Hall. *Presiding,* Elmer Headlee.

"The National Defense Education Act: Policies, Problems, and Promises," Dr. Herbert A. Smith, *President of NSTA;* U. S. Office of Education, Washington, D. C.

"The NSTA Program of Activities," Robert H. Carleton, *Executive Secretary,* Washington, D. C.

Committees

Local Program Chairman: Norman R. D. Jones, Assistant Professor of Biology, Harris Teachers College, St. Louis, and third NSTA president.

Cooperating: 125 teachers of the Teacher Committee, Greater St. Louis Science Fair.

Meeting Rooms and Facilities: Norman R. D. Jones.

Registration, Membership, and Publication Tables: Mrs. Zena Henley; Miss Virginia Jackson; Mrs. Eva H. McKee; B. Everett Owings; Miss Ruth Rice; Mrs. Ruth Q. Shay.

Seating and Hospitality: J. W. Knight, Chairman; Brother L. Charles, F.S.C.; Brother Henry Alfred, F.S.C.; Brother I. Jerome, F.S.C.; Edward Tines.

NEA Department Presidents

Annual meeting of Presidents of all NEA departments will be held May 10-12 at NEA headquarters in Washington, D. C. Representing NSTA will be President Herbert A. Smith and President-Elect Donald G. Decker. In these annual meetings, problems of broad, general concern are taken up, such as membership promotion, legislation, and the improvement of curricula and instruction. Significant interdepartmental projects are often developed at these meetings.

TEPS Conference

Three NSTA Officers will represent the Association at the 14th annual conference of the NEA Commission on Teacher Education and Professional Standards, which will meet June 23-26, at the University of Kansas. As at the Bowling Green (Ohio) conference last year, fifty or more educational, scientific, and other professional societies will co-sponsor the conclave. A prime purpose is to develop a partnership attack by educators and others for the crucial issues of the content of teacher-education curricula.

SCIENCE TEACHING MATERIALS

Prepared by NSTA Teaching Materials Review Committee
Dr. Robert A. Bullington, Chairman
Northern Illinois University, Dekalb

BOOK BRIEFS

A Laboratory Manual for High School Biology. Thomas H. Knepp. 80p. $2. J. Weston Walch, Box 1075, Portland, Maine. 1958.

An offset-printed, plastic-bound laboratory manual, geared to the usage of simple and inexpensive facilities and equipment. Microscopes and other extensive equipment are not required. Emphasizes the morphological aspect of biology by giving directions for examining and drawing representative forms. Teacher's guide, containing actual student drawings, free with each order.

Basic Aeronautical Science and Principles of Flight. Robert D. Black. 242p. $5.95. American Technical Society, 848 E. 58th St., Chicago 37, Ill. 1958.

This book, written by a licensed commercial pilot and instructor in high school aeronautics, is prepared specifically for those who are studying aeronautics for the first time. Treats the history and development of modern aircraft, career opportunities in aviation, fundamental laws of aerodynamics, and the procedures of flying an aircraft. A self-examination and written assignment appear at the end of each chapter. Suitable for high school.

Electricity and Electrons—Basic. William B. Steinberg and Walter B. Ford. 246p. $4.50. American Technical Society, 848 E. 58th St., Chicago 37, Ill. 1957.

Fundamentals of electricity and electrons are simply described. Examples of electrical measurements are given. Contains a large number of applications from everyday life experiences.

The Amazing Book of Birds. Hilda Simon. 128p. $3.75. Hart Publishing Co., 74 Fifth Ave., New York, N. Y. 1958.

Introduction to the fascinating world of birds. Features many unusual facts as well as a comprehensive study of bird life. Certain to interest the student and encourage him to go further in the study of birds. For junior high level, also useful in senior high.

Modern Chemistry. Charles E. Dull, H. Clark Metcalfe, and John E. Williams. 696p. $5.20. Henry Holt & Co., 383 Madison Ave., New York 17, N. Y. 1958.

A complete revision of one of the leading textbooks for the standard high school chemistry course. Reflects recent progress in all areas of chemistry, with appropriate emphasis on the modern concepts of atomic structure, chemical bonding, ionization, oxidation-reduction reactions, and chemical equilibrium.

The order of presentation of topics has been radically revised with atomic structure, the Periodic Law, and chemical bonding being introduced in Unit Two. By learning these fundamentals in the first weeks the student gains an adequate background for understanding the more advanced theories and principles which explain the relationships between structure and the properties of substances.

The accompanying combination laboratory manual and workbooks have been revised to include 45 helpful exercises and an abundance of appropriate laboratory exercises, many of which give the student an opportunity to carry out a careful quantitative investigation. Two alternate forms of Unit Tests are also provided for use.

Fieldbook of Natural History. Revised Edition. E. Laurence Palmer. 664p. $9. McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, N. Y. 1958.

The new printing of this valuable classroom and field reference includes corrections to bring generic and specific names up-to-date. A composite guide to stars, the solar system, rocks and minerals, common plants of all major groups, and invertebrate and vertebrate animals. Both wild and domestic species are included. Each item covered with complete classification, clear drawing, and written information. Should be available in every classroom where nature is studied.

Difco Manual of Dehydrated Culture Media and Reagents for Microbiological and Clinical Laboratory Procedures. Ninth Edition. 350p. Free. Difco Laboratories, Inc., Detroit 1, Mich. 1958.

A valuable reference for the biology teacher and student working in the field of microbiology. A standard guide to microbiologists since the first edition in 1927.

SCIENCE TEACHING TECHNIQUES. I-VII. Published for the Association of Teachers on Colleges and Departments of Education, the Association of Women Science Teachers, the London Association of Science Teachers, and the Science Masters Association. Numbers III-VII, 64p. 3 shillings net (approximately 42 cents) each. Postal money orders should be sent to John Murray, Albemarle Street, London, W.I. 1959.

This is a series of British publications on science teaching in secondary schools. Many of the suggestions offered would be appropriate in American science classrooms grades 7 through 12.

Numbers I and II are out of print. Individual articles in Number III deal with a variety of subjects including experiments with soil, feeding frogs in captivity, and an experimental approach to alternating current; in Number IV with surface tension, marine studies, and bacteriology; in Number V with introductory astronomy, photographs, and the school greenhouse; in Number VI with the preparation of distilled water, genetics on the form, and the study of light; and in Number VII, with nuclear energy, geology, and general science laboratory equipment.

DIGGING INTO YESTERDAY. Estelle Friedman. 160p. $2.95. G. P. Putnam's Sons, 210 Madison Ave., New York 16, N. Y. 1958.

For ages 10 and up. Covers archeology in general. Points up the relationship between the historian and the archeologist. Skipping around the globe it covers some of the most interesting finds in South America, Mesopotamia, and the Mediterranean area. Excellent for the beginning student of archeology. Interesting maps and drawings accompany each chapter.

THE TOOLS OF SCIENCE. Irving Adler. 128p. $3. The John Day Company, 210 Madison Ave., New York 16, N. Y. 1958.

Upper elementary and junior high school level. Describes the tools used by scientists both past and present. Tells the story of how man observes, analyzes, and changes his universe through the use of scientific instruments. Emphasis is put on the tools used by the modern-day physicist. Numerous illustrations and actual photographs of modern instruments.

ATOMS TODAY AND TOMORROW. Margaret O. Hyde. 156p. $3. McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, N. Y. 1959.

Introduces fundamentals of atomic theory, energy, atom smashing, atomic piles, and radiation. Stresses peaceful uses with relationship to medicine, agriculture, electricity, and travel. Recommended for junior high.

RUDIMENTS OF WEATHER. John A. Day and Fred W. Decker. 97p. $2. O. S. C. Cooperative Association, Box 491, Corvallis, Ore. 1958.

The title of this paper-bound, loose-leaf book describes its contents accurately. Only elements of weather are

included. Does *not* include forecasting. Starts with clouds and measuring instruments and, using energy as the unifying theme, continues through various elements to cyclonic circulation, precipitation, and radiation. Useful for high school and elementary college courses.

We Are in a Race to Conquer Outer Space. Chester A. Fritts. 106p. $2.95. Vantage Press, Inc., 120 W. 31 St., New York 1, N. Y. 1958.

This book is written to evaluate the science curricular needs of the secondary schools. It urges that changes be made in the curriculum to recruit more young people into studies dealing with aspects of the space sciences. The author has developed his thesis more on an emotional than an analytical basis. He deals with aspects of religion, heaven, and fairy stories in his attempt to evaluate man's academic obligations to space studies.

Flashing Harpoons: The Story of Whales and Whaling. R .Frank, Jr. 183p. $3. Thomas Y. Crowell Co., 432 Fourth Ave., New York 16, N. Y. 1958.

Describe the various kinds of whales, whale hunting, whaling ships, and whaling industry. Illustrated to augment a fact-filled story of the largest mammal. A fascinating and informative source for junior high students.

APPARATUS and EQUIPMENT

Physics Kit. A collection of simple items designed to make it possible for the junior high teacher without previous training to present a physics program. Topics covered include nuclear physics, measurement, heat, sound, light, magnetism, electricity, and mechanics. Includes a manual written to "teach the teacher," with traditional physics experiments in simplified form. Hardwood case, $56. Atomic Laboratories, Inc., 3086 Claremont Ave., Berkeley 5, Calif.

Junior Scientist's Static Electricity Kit. Contains nets, compass, various grades of iron filings, and many additional small parts for conducting 75 experiments. With teacher's manual. $3.50.

Junior Scientist's Static Electricity Kit. Contains vermiculite, neon bulb, plastic strips, nylon cloth, polyethylene sheet, cotton and nylon thread, and plastic dishes with additional parts. With teacher's manual. $2.50.

These two kits are very compact and well suited for teaching basic science concepts to elementary students. Science Materials Center, 59 Fourth Ave., New York 3, N. Y.

Hydroelectric Dam and Generator Kit. This extremely well-planned kit gives the teacher a great range of versatility in planning integrated experiments in electricity, properties of fluid flow, and basic geological engineering. Kit consists of a complete dam site with all the necessary electrical and mechanical equipment for producing and measuring AC or DC voltages from a harmless 6 volts to 110 volts AC. Unit is very useful and can be used intelligently in grades 5 through senior high physics. $99.85. Product Design Co., 2796 Middlefield Road, Redwood City, Calif.

CHART: "THE CHEMICAL ELEMENTS." By Philip S. Chen. $1. Revised 1959. A condensation in tabular form on a large wall chart (3'x4') of the name, derivation, discovery, electron structure, isotopes, physical properties, occurrence, preparation, and use of the known elements. Chart is arranged vertically by periodic table groups. Several auxiliary tables—radioactive elements, distribution of element, production—are placed at the bottom. Handy reference source, but not suitable for general classroom use because of the small print. The Chemical Elements, Box 315, South Lancaster, Mass.

AUDIO-VISUAL AIDS

MINERALS ON PARADE. A set of three color filmstrips very useful in any elementary or secondary class studying minerals. Shows collection procedures and methods of identification in the laboratory by physical and chemical properties. Photographs of 26 basic minerals are preceded by descriptive cartoons showing the use of each. Accompanied by descriptive booklet. Usefulness would be much enhanced by presence of actual minerals for examination. Color, $24 per set. 1958. Sweetman Productions, Walnut Hill Road, Bethel, Conn.

LIFE IN A CUBIC FOOT OF AIR. This film briefly reviews the chemical composition of the atmosphere illustrating through simple experimentation the host of living and non-living matter in the air. Microphotography and stop-motion photography are used to demonstrate cell development in microscopic plants and animals. Excellent for junior high. 11 min. Color $110, B&W $60. 1958. Coronet Films, Coronet Building, Chicago 1, Ill.

ENGINES AND HOW THEY WORK. Engines are classified according to principles of operation. Illustrates principles and application of three main types of heat engines —reciprocating, rotary, and reaction. Emphasizes whether internal or external combustion involved. Animation and working models used to advantage. Excellent for junior high. 11 min. Color $110, B&W $60. 1958. Coronet Films, Coronet Building, Chicago 1, Ill.

LIFE OF THE MOLDS. Effectively illustrates vegetative, asexual reproduction, and sexual reproductive structures. Economic importance of the fungi is stressed. Minimum use of technical terminology makes film suitable for students at secondary and college levels. Excellent for use in biology, botany, mycology, and bacteriology. 21 min. Color $165, B&W $85. 1958. Produced by Chas. A. Pfizer and Co., Inc., 800 Second Ave., New York 17, N. Y., and distributed by McGraw-Hill Text Films, 330 W. 42nd St., New York 36, N. Y.

THE TREES ON OUR STREETS. A useful filmstrip for city schools. Good color photographs show the vegetative and reproductive characteristics of some common shade trees—sycamores, American elm, ginkgo, maples, honey locust, and pin oaks. Attention is given to two enemies of trees, the Dutch elm disease and Tussock moth. An excellent script gives detailed information about each picture. 42 frames. Color $6. 1958. The American Museum of Natural History, 79th Street and Central Park West, New York 24, N. Y.

SATELLITES: STEPPING STONES TO SPACE. An excellent film introducing the problems of rockets and satellites. Filming of actual and diagrammatic scenes is well done. Film defines and demonstrates the satellite and rocket engine, and shows the rocket firing of Explorer I. Explains the forces acting on a satellite. Suitable for intermediate and junior-senior high school. 17½ min. Color $170, B&W $90. 1958. Film Associates of California, 10521 Santa Monica Boulevard, Los Angeles 25, Calif.

DESIGN FOR ABUNDANCE. Color film story of plant diseases produced by The American Phytopathological Society in celebration of its fiftieth anniversary. Designed for high school biology, but very effective for junior high and college. In clear, non-technical language a plant pathologist tells a neighboring family about plant diseases —their cause, treatment, prevention, and methods of control. Actual research work on various diseases is shown and explained. A valuable education film contribution. 23 min. Color $145. 1958. Distributed by Atlas Film Corporation, 1111 South Boulevard, Oak Park, Ill.

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